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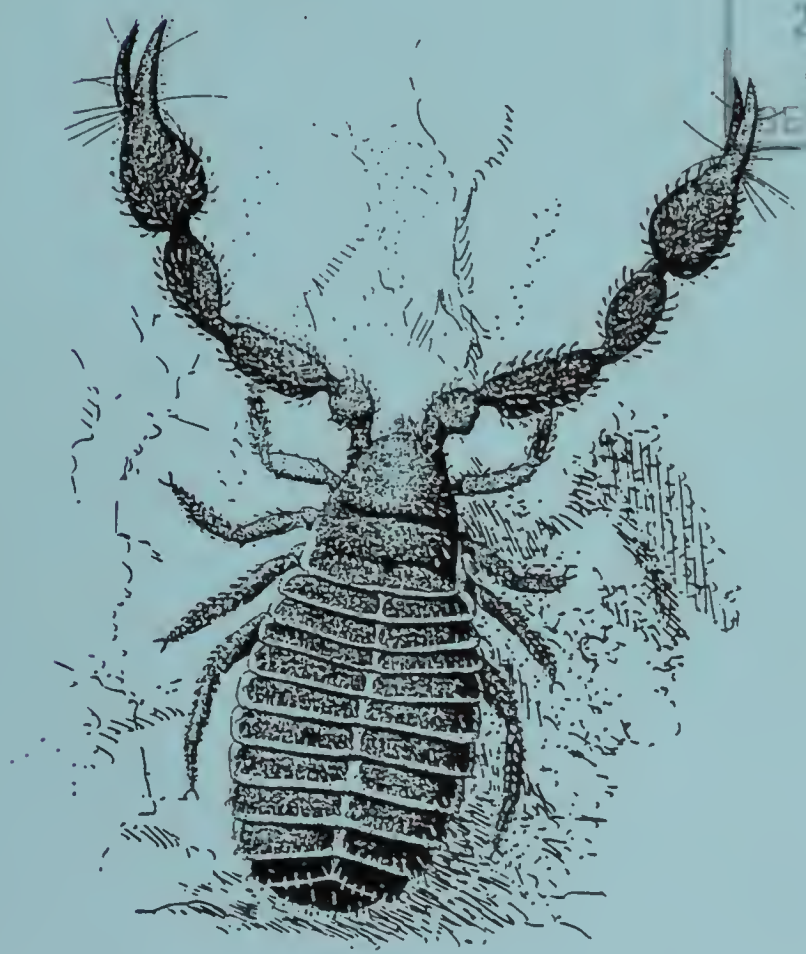
# TRANSACTIONS of THE NORFOLK & NORWICH NATURALISTS' SOCIETY

**Vol. 30 Part 5 (June 1996)**





TRANSACTIONS OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY

ISSN 0375 7226 Volume 30 Part 5 (June 1996) Editor P.W. Lambley

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# CREEPY CRAWLIES

## THE PRESIDENTIAL ADDRESS DELIVERED TO THE SOCIETY ON 26 FEBRUARY 1996

R. E. Jones
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Until quite recently creepy crawlies have had a raw deal in Norfolk, if not most parts of Britain, when they are compared with the popularity of birds or plants. By creepy crawlies I mean of course the ragbag of groups that do not readily fit in elsewhere: the woodlice, false-scorpions, centipedes, millipedes, harvestmen and even the terrestrial flatworms.

This is apart from Ted Ellis (1945, 1972) who as you all know studied almost everything there was; Brade-Birks who looked at Norfolk's myriapods (Brade-Birks, 1920); A. E. Ellis (1942, 1943 & 1946) who made a foray into the woodlice and harvestmen in the 1940's; and Sadler (1970) who found a new harvestman for the county. There was little to go on until 1976 when Paul Harding published the Provisional Isopod Atlas (1976a) and found *Eluma purpurascens* in Norfolk (1976b).

In the last few years there has been an array of books and keys that enable the identification of many, though not all, of these groups (Eason, 1964; Sutton, Harding & Burn, 1972; Blower, 1985; Legg & Jones, 1988; Hillyard & Sankey, 1989; Hopkin, 1991; Oliver & Meechan, 1993). Since the 70s and particularly in the 80s and early 90s, there has been a steady increase nationally in the knowledge of their habits and distribution, aided for the most part by the Biological Records Centre at Monks Wood (Barber & Keay, 1988; BMG, 1989; Harding,1985; Harding & Sutton, 1985; Sankey, 1988).

### County lists

It is over ten years since the woodlouse fauna was published for Norfolk and the false scorpions, centipedes, millipedes and harvestmen have all followed at intervals (Irwin & Jones, 1984; Jones, H. D. 1988; Jones, R. E. 1985b; 1986; 1987; 1988; 1989; 1990, 1991; Jones, Proeter & Foster, 1992). One might think that from the point of view of recording new species that was that but already *Dicranopalpus ramosus*, a harvestman, has been recorded from the county (Hancy, 1994). It was found less than a year after the Norfolk list was published.

The following lists give the state of play at the moment. Note that some species still have to be found in *both* vice-counties.

| | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| **Woodlice Isopods** | | |
| *Ligia oceanica* (L.) | • | • |
| *Ligidium hypnorum* (Cuvier) | • | • |
| *Androniscus dentiger* Verhoeff | • | • |
| *Buddelundiella cataractae* Verhoeff | | • |
| 1*Haplophthalmus danicus* Budde Lund | • | • |
| *H. mengei* (Zaddach) | • | • |
| *Trichoniscoides albidus* (Budde Lund) | • | • |
| *T. saeroeensis* Lohmander | • | |
| *Trichoniscus pusillus* Brandt | • | • |
| *T. pygmaeus* Sars | • | • |
| 2*Stenophiloscia zosterae* (Verhoeff) | | • |
| *Oniscus asellus* L. | • | • |
| *Philoscia muscorum* (Scopoli) | • | • |
| *Platyarthrus hoffmannseggi* Brandt | • | • |
| *Armadillidium album* Dollfus | | • |
| *A. nasatum* Budde Lund | • | • |
| *A. vulgare* (Latrielle) | • | • |
| *Eluma purpurascens* Budde Lund | • | |
| *Cylisticus convexus* (DeGeer) | • | • |
| *Porcellio dilatatus* Brandt | • | • |
| *P. laevis* Latreille | • | • |
| *P. scaber* Latreille | • | • |
| *P. spinicornis* Say | • | • |
| *Porcellionides pruinosus* (Brandt) | • | • |
| *Trachelipus rathkei* (Brandt) | | • |

1 Since the list was first published another species called *Haplophthalmus montivagus* has been found in Britain. It has not been found amongst the specimens in the museum but it may occur here.
2 See Harding, Cotton & Rundle, 1980

| | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| **False scorpions Pseudoscorpions** | | |
| *Chthonius ischnocheles* (Hermann) | • | • |
| 3*C. tenuis* L. Koch | | ? |
| 4*C. tetrachelatus* (Preyssler) including *C. kewi* Gabbut. | • | • |
| *Neobisium muscorum* (Leach) | • | • |
| *Roncus lubricus* L. Koch | • | • |
| *Cheridium museorum* (Leach) | • | • |
| 5*Lamprochernes godfreyi* (Kew) | • | |
| *L. nodosus* (Schrank) | • | • |

| | | |
|---|---|---|
| *L. chyzeri* (Tömösváry) | • | • |
| *Pselaphochernes scorpioides* (Hermann) | • | • |
| *P. dubius* (O.P. Cambridge) | • | • |
| *Allochernes powelli* (Kew) | | • |
| *Dinocheirus panzeri* (C.L. Koch) | • | • |
| *Chernes cimicoides* (Fabricius) | • | • |
| *Dactylochelifer latreillei* (Leach) | • | • |

3 This species is probably only on the Norfolk list due to an introduction. (Jones, 1985)
4 These two species are, I think, one and the same.
5 The three Lamprochernes species are in need of checking. They certainly occur in the county but *L. chyzeri* is certainly under recorded and it is hard to tell from *L. nodosus* even when it is under a microscope.

| **Harvestmen Opiliones** | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| *Nemastoma bimaculatum* (Fabricius) | • | • |
| *Mitostoma chrysomelas* (Hermann) | • | • |
| *Anelasmocephalus cambridgei* (Westwood) | • | • |
| *Oligolophus tridens* (C. L. Koch) | • | • |
| *Paroligolophus agrestis* (Meade) | • | • |
| *Lacinius ephippiatus* (C. L. Koch) | • | • |
| *Odellius spinosus* (Bosc) | • | • |
| *Mitopus morio* (Fabricius) | • | • |
| *Phalangium opilio* Linnaeus | • | • |
| *Opilio parietinus* (DeGeer) | • | • |
| *O. saxatilis* (C. L. Koch) | • | • |
| *Megabunus diadema* (Fabricius) | • | • |
| *Rilaena triangularis* (Herbst) | • | • |
| *Lophopilio palpinalis* (Herbst) | • | • |
| *Dicranopalpus ramosus* (Simon) | • | |
| *Leiobunum rotundum* (Latreille) | • | • |
| *L. blackwalli* Meade | • | • |
| *Nelima gothica* Lohmander | • | • |

| Centipedes Chilopoda | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| *Haplophilus subterraneus* (Shaw) | • | • |
| *Schendyla nemorensis* (C. L. Koch) | • | • |
| *Brachyschendyla dentata* Brölemann & Ribaut | • | • |
| *Henia brevis* (Silvestri) | • | |
| *Strigamia crassipes* (C. L. Koch) | • | • |
| *S. acuminata* (Leach) | • | • |
| *S. maritima* (Leach) | | • |
| *Geophilus carpophagus* Leach | • | • |
| *G. electricus* (L.) | • | • |
| *G. fucorum serauti* Brölemann | • | |
| *G. insculptus* Attems | • | • |
| *Necrophloeophagus flavus* (DeGeer) | • | • |
| *Brachygeophilus truncorum* (Bergso & Meinert) | • | • |
| *Cryptops hortensis* Leach | • | • |
| *C. parisi* Brölemann | | • |
| *Lithobius forficatus* (L.) | • | • |
| *L. melanops* Newport | • | • |
| *L. borealis* Meinert | • | • |
| *L. calcaratus* C. L. Koch | • | • |
| *L. crassipes* L. Koch | • | • |
| *L. curtipes* C. L. Koch | • | • |
| *L. microps* Meinert | • | • |
| *Lamyctes fulvicornis* Meinert | • | • |
| *Scutigera coleoptrata* (L.) | • | |

| Millipedes Diplopoda | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| *Polyxenus lagurus* (L.) | • | • |
| *Glomeris marginata* (Villers) | • | • |
| *Stygioglomeris crinata* Brölemann | • | • |
| *Nanogona polydesmoides* (Leach) | • | • |
| *Craspedosoma rawlinsii* Leach | • | • |
| *Brachychaeteuma bradeae* (Brölemann & Brade-Birks) | • | • |
| *Nemasoma varicorne* C.L. Koch | • | • |
| *Thalasissobates littoralis* (Silvestri) | • | |
| *Proteroiulus fuscus* (Am Stein) | • | • |
| *Nopoiulus kochii* (Gervais) | | • |
| *Blaniulus guttulatus* (Fabricius) | • | • |
| *Archiboreoiulus pallidus* (Brade-Birks) | • | |
| *Boreoiulus tenuis* (Bigler) | • | • |
| *Tachypodoiulus niger* (Leach) | • | • |

| | | |
|---|---|---|
| *Ommatoiulus sabulosus* (L.) | • | • |
| *Brachyiulus pusillus* (Leach) | • | • |
| *Julus scandinavius* Latzel | • | • |
| *Ophyiulus pilosus* (Newport) | • | • |
| *Allajulus nitidus* (Verhoeff) | • | • |
| *Cylindroiulus caeruleocinctus* (Wood) | • | • |
| *C. londinensis* (Leach) | • | |
| *C. punctatus* (Leach) | • | • |
| *C. latestriatus* (Curtis) | • | • |
| *C. britannicus* (Verhoeff) | | • |
| *C. parisiorum* (Brölemann & Verhoeff) | • | • |
| *Leptoiulus belgicus* (Latzel) | | • |
| *Unciger foetidus* (C.L. Koch) | | • |
| *Brachydesmus superus* Latzel | • | • |
| *Polydesmus angustus* Latzel | • | • |
| *P. gallicus* Latzel | • | • |
| *P. inconstans* Latzel | • | • |
| *P. denticulatus* C.L. Koch | • | • |
| *Ophiodesmus albonanus* (Latzel) | • | • |
| *Macrosternodesmus palicola* Brölemann | • | • |

*Unciger* which was discovered in Dersingham in 1983 is still going strong in the garden where it was found.

| | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| **Flatworms (terrestrial)** | | |
| *Microplana terrestris* (Müller) | • | • |
| *M. humicola* Vejdovsky | • | |
| *Artioposthia triangulata* (Dendy) | • | |

Found at Smallburgh (Jones, 1985)
Found at Bressingham.

| | East Norfolk vc 27 | West Norfolk vc 28 |
|---|---|---|
| **Nemertines (terrestrial)** | | |
| *Argonemertes dendyi* (Dakin) | • | |

Found at Norwich.

Recently, (Barber & Jones in press) I have come to the conclusion that many of our assumed natural fauna which are widespread in this country are actually aliens (see Corbet, 1961, 1962). By this I mean that although they now fit happily into their niches in this country, they originally reached here by boat or even by aeroplane! When the ice retreated at the end of the last ice age there was a gradual colonisation

of northern Europe. Only a few species would have made it to Britain before it was cut off from the continent about ten thousand years ago by the opening of the Channel. From then on any creature that could not fly was cut off from Britain unless it could hitch a lift with man. The first colonists probably came with Stone or Bronze Age boatmen and the latest with jet aircraft.

The only way to see if this is still happening is to monitor our fauna continually. *Unciger foetidus* came to Britain as a result of a gradual colonisation of central Europe and it crossed the sea by some means or other to be found in Dersingham in 1983 (Jones, 1985a). What will come in the future? In order to find out how the populations change due to natural expansion and contraction, we need to know their whereabouts now. In a perfect world, we should have also known the ranges in the past as well as those that we shall learn about in the future. Some people say that *Chordeuma proximum, Melogona gallica* and *M. scutellare* have increased their range in the last thirty years, others say that they were there all the time but were overlooked. One thing is sure, they do not occur in East Anglia, AT THE MOMENT. In fifty or a hundred years time, particularly with global warming to add to the equation, things may be different.

Conversely, things that were once common are becoming rare. *Allochernes powelli* was found in old field barns in the 1980s but in the past few years the barns have vanished. They are now pulled down or, in some cases, they have been converted into luxury homes. A survey now may find that *A. powelli* has become extinct in Norfolk.

I shall not be here when the two hundredth anniversary of the Norfolk and Norwich Naturalists' Society is with us, but some of you should be and will, I hope, be able to answer some of the distribution questions that occur then.

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# THE CAMBERWELL BEAUTY INVASION

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The long hot summer of 1995 will long be remembered for its invasion of Camberwell Beauty butterflies (*Nymphalis antiopa*). Norfolk received its full share of these exotic insects each displaying dark chocolate upperwings bordered in blue and cream. The county total was over 70 examples. Where sightings extended over several days it has been assumed only one individual was involved. Almost most observations were of singles, but one fortunate observer discovered a group of four in his Smallburgh garden which stayed a full half-hour. Ever active bird-watchers provided a considerable number of Camberwell Beauty sightings. details of these were made available by Birdline East Anglia based in Norwich, the Natural History Department at the Castle Museum, the Norfolk Branch of Butterfly Conservation, the National Recorder of Butterfly Conservation and local press correspondents. As a result the invasion has been well documented. In Suffolk the County Recorder received 38 observations from 32 localities.

Norfolk sightings were reported from Barnham Broom, Blakeney Point, Bunwell, Catfield, Cley, Cromer, Dersingham, Earsham, Eaton, Fakenham, Felbrigg Park, Gorleston, Great Yarmouth, Hainford, Holkham Park including the Garden Centre, Holkham National Nature Reserve, Hopton, Horsey, Larling, Little Ellingham, Newton Flotman, Norwich, Old Catton, Oulton (near Aylsham), Pensthorpe, Ridlington, Salthouse, Saxlingham Green, Sharrington, Sheringham, Smallburgh, Sparham, Stalham, Strumpshaw, Waxham, West Acre and West Runton.

Camberwell Beauties were reported in large numbers crossing Denmark and the Netherlands before reaching England. At the time it was assumed these travellers had come from Southern Scandinavia. However, there were relatively low numbers in Norway and Sweden in 1995 suggesting this year's migrants may have journeyed from much further east, possibly Poland or even Russia. Both countries, according to Butterfly Conservation, have enjoyed good breeding conditions early in the year whilst Scandinavia suffered cooler, damp weather.

By August 3rd there were many Camberwell Beauty reports from Sussex in the south-east to Cheshire in the north-west and from all points in between. The immigrants then moved north to Shetland and south to Cornwall and west to Ireland. The largest concentrations, as expected, were along eastern coasts. In Norfolk sightings extended from the beginning of July until the second week in October. Many sightings were in gardens reflecting the joint attraction of nectar and fallen fruits. Several reports came from observers baiting them with over-ripe

bananas.

The earliest collectors knew the Camberwell Beauty as the Grand Surprise on account of its unexpected and striking appearance. It is quite unlike any other European species. The first two adults reported in 1748 were flying round willows along Cold Arbour Lane near Camberwell. The earliest Norfolk occurrence was in 1834 when one was taken in the old North End Gardens in Yarmouth. It has been a regular visitor ever since, but in most years only odd ones are seen. The last great Camberwell Beauty year was 1976 when a countrywide total of 270 was listed. This figure included 43 in Norfolk and 17 in Suffolk.

It has been suggested some Camberwell Beauties seen here are 'ship-assisted". One was seen flying from the hold of a Norwegian timber ship discharging in Felixstowe Docks in 1969. On an earlier occasion when light vessels were manned a specimen came to rest on a ship's boat at Corton lightship and when disturbed flew strongly westward". After an invasion there are often reports of Camberwell Beauties the next spring following re-emergence in April.

## THE SLUG *LIMAX CINEREONIGER*, NEW TO NORFOLK

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There is comparatively little information on the invertebrates of Swanton Novers Great Wood, despite the fact that it is a National Nature Reserve and one of the most diverse woods in East Anglia. To begin to remedy this situation an invertebrate survey of Swanton Novers Great Wood was started in the summer of 1995 using various methods including pitfall traps. The full details will be published in due course.

During this study Britain's largest slug *Limax cinereoniger* Wolf was found at two localities within the wood on the 13th June and 16th July. This ancient woodland species is well distributed in the west of Britain but much more patchily distributed in the south-east. In East Anglia it is particularly rare though it is recorded from Wolves Wood in Suffolk. This is the first record from Norfolk.

I am grateful to Mathew Shardlow for confirming the identification

# NORFOLK EPHEMEROPTERA - AN UPDATE

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## Introduction

Since the "Review and preliminary survey of Norfolk Ephemeroptera" was published (Farrow, 1995) a number of interesting facts have emerged and the following account summarises some of this new information.

## Discussion

Following receipt of historical data held by the Institute of Freshwater Ecology for Ephemeroptera in Norfolk it has been noted that two further species have been recorded within the county. These two latest additions to the county are *Brachycercus harrisella* Curtis and *Paraleptophlebia cincta* (Retzius). Both were recorded from the upper Bure in 1987, each from one site only (see maps). The single record of each species from a river that has been surveyed frequently in the past 20 years must place them in the rarity category. As other species may also be awaiting discovery the current British check list is given (Table 1) and those mayflies that have been recorded and subsequently confirmed for Norfolk are indicated.

In addition to the "new" species further historical records of a former species believed to have had only one or two occurrences within the county have been submitted. This is *Ephemera vulgata* Linnaeus, which was noted at Hoveton Gt. Broad in 1969 when"several dozen dead sub-imagines were stuck to a large noticeboard and litterbin after heavy rain" (P. Cobb *per. comm.*). Apparently they were also present in the area in 1970 and 1972 (P. Cobb / J. Buckley *pers. comm.*). A male collected in 1969 by P. Cobb was given to the author for confirmation in 1995. It is interesting that E. A. Ellis considered *Ephemera danica* Muller as the only large mayfly of the Broads, however the statement was made prior to the above sightings (Ellis, 1965). Another record of the species has also come from the IFE listing and refers to the River Thet in 1982. It is possible that this species is a casual breeder in favourable years where suitable habitat occurs i.e. generally quiet muddy areas of rivers.

Further field work in 1995 by the author, especially in the upper reaches of the Bure, confirmed the presence of *Paraleptophlebia submarginata* (Stephens) and Dr. R. E. Baker, during pond/dyke dipping at Wheatfen, re-confirmed *Caenis robusta* Eaton, a species new to Britain in 1951 when Dr. T. T. Macan first discovered it there (Macan, 1961).

An additional record of *Centroptilum luteolum* Muller was also received when one was caught in a Norwich moth light trap during 1990 (R. Rogers *pers. comm.*). Mayflies often turn up in such light traps but many are damaged beyond recognition, however, *Caenis horaria* Linnaeus was similarly caught on Sheringham Common by the author in 1995.

Further research of the records held at the Castle Museum, notably a succession of Broadland Dyke surveys carried out during the 1970's and early 1980's by R. J. Driscoll and others, revealed a wider distribution of *Cloeon simile* Eaton than previously shown.

## Conclusion

Such is the diversity of the Ephemeroptera recorded for Norfolk i.e. 27 species that it is possible others remain undetected. As some of the species recorded are of single records it may be down to their rarity or to the luck of the particular investigation. As with most organisms in nature they are not static and an ebb and flow of species through climate, habitat changes or accident could produce more "new" species in time which may, of course, be balanced by a loss of others.


## Acknowledgements

My thanks to Dr. P. Armitage of the Institute of Freshwater Ecology for the database listing, to R. J. Driscoll and members of the Castle Museum Natural History Department for their assistance in finding records and references, to P. Cobb, J. Buckley, Dr. R. E. Baker and R. Rogers for sending me their records and observations. The maps were produced by DMAP, a distribution mapping programme developed by Dr. A. J. Morton.


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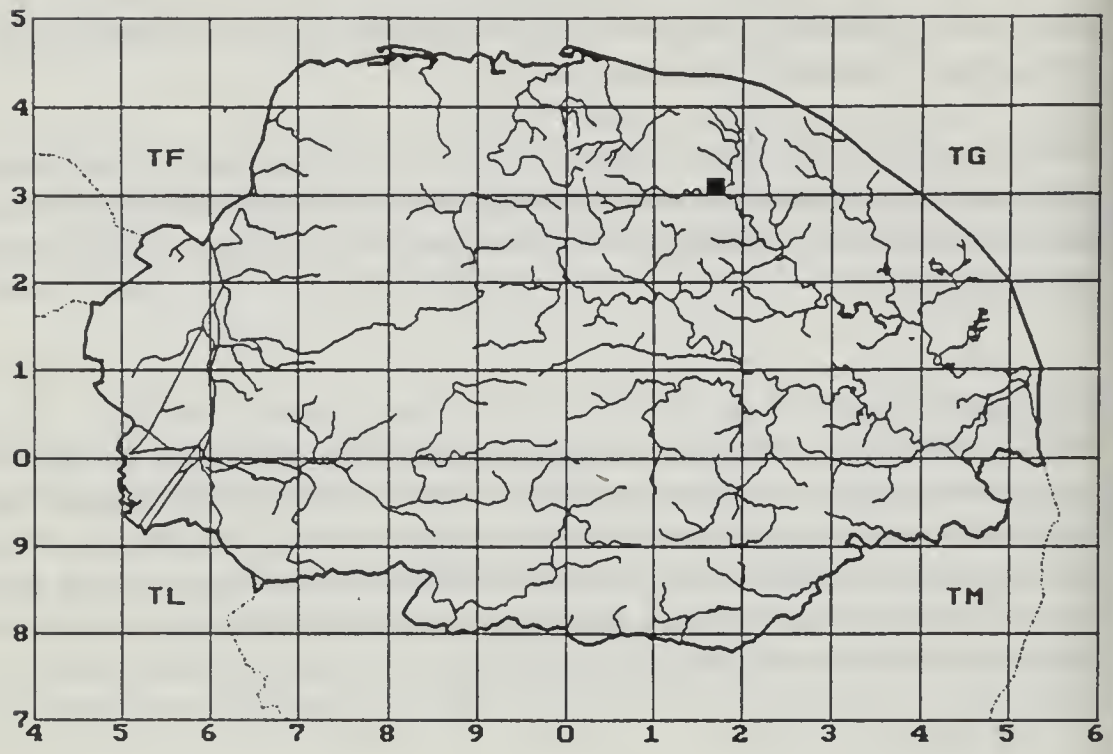
Brachycercus harrisella




Paraleptophlebia cincta

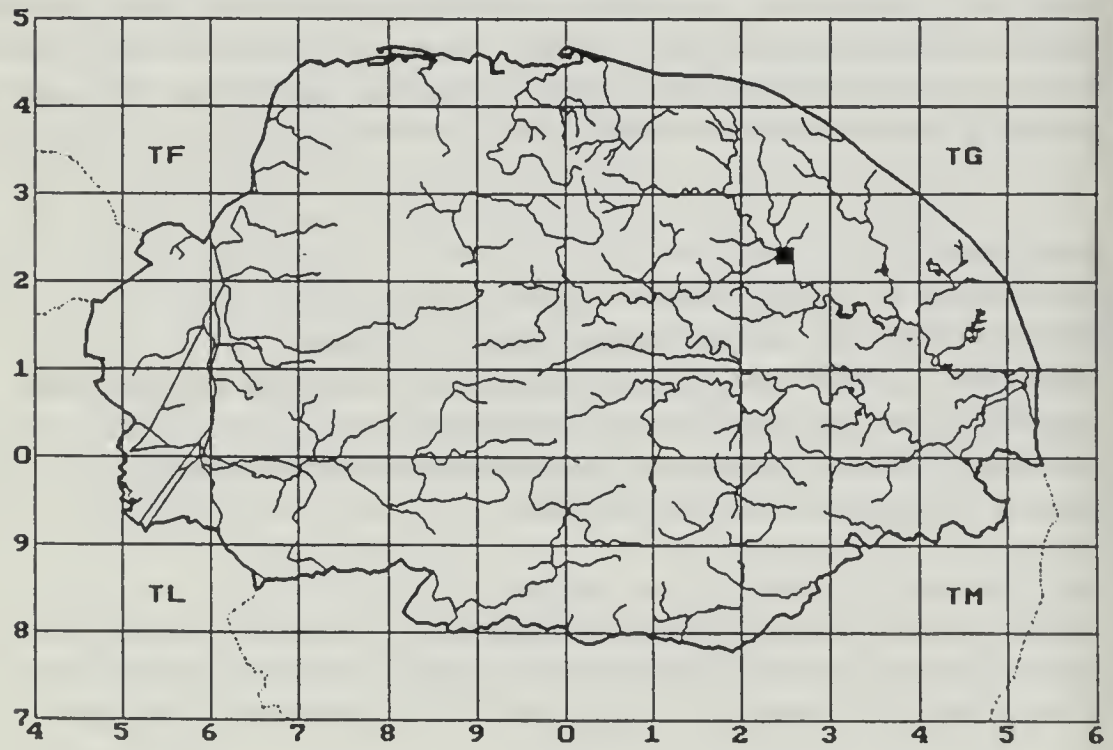


**Table I.** Check list of British Ephemeroptera with Norfolk recorded species (pre-1990) or confirmed species (post-1990) indicated.

| Species | Recorded/ confirmed (X) | (XX) | |
|---|---|---|---|
| **Family Baetidae** | | | |
| *Baetis atrebatinus* Eaton, 1870 | | | |
| *Baetis buceratus* Eaton, 1870 | | | |
| *Baetis digitatus* Bengtsson, 1912 | | | |
| *Baetis fuscatus* (Linnaeus, 1761) | | X | |
| *Baetis muticus* (Linnaeus, 1758) | | X | |
| *Baetisniger* (Linnaeus, 1761) | | X | |
| *Baetis rhodani* (Pictet, 1844) | | XX | |
| *Baetis scambus* Eaton, 1870 | | XX | |
| *Baetis vernus* Curtis, 1834 | | XX | |
| *Centroptilum luteolum* (Muller, 1776) | | XX | |
| *Centroptilum pennulatum* Eaton, 1870 | | XX | |
| *Cloeon dipterum* (Linnaeus, 1761) | | XX | |
| *Cloeon simile* Eaton, 1870 | | X | |
| *Procloeon bifidum* (Bengtsson, 1912) | | X | |
| **Family Caenidae** | | | |
| *Brachycercus harrisella* Curtis, 1834 | | X | |
| *Caenis horaria* (Linnaeus, 1758) | | XX | |
| *Caenis luctuosa* (Burmeister, 1839) | | XX | |
| *Caenis macrura* Stephens, 1835 | | X | |
| *Caenis rivulorum* Eaton, 1884 | | X | |
| *Caenis robusta* Eaton, 1884 | | XX | |
| *Caenis pusilla* Navas, 1913 | | | |
| **Family Ephemeridae** | | | |
| *Ephemera danica* Muller, 1764 | | XX | |
| *Ephemera lineata* Eaton, 1870 | | | |
| *Ephemera vulgata* Linnaeus, 1758 | | XX | 1969 specimen |
| **Family Ephemerellidae** | | | |
| *Ephemerella ignita* (Poda, 1761) | | XX | |
| *Ephemerella notata* Eaton, 1887 | | | |

| | |
|---|---|
| *Ecdyonurus venosus* (Fabricius, 1775) | |
| *Arthroplea congener* Bengtsson, 1909 | |
| *Heptagenia fuscogrisea* (Retzius, 1783) | |
| *Heptagenia lateralis* (Curtis, 1834) | |
| *Heptagenia longicauda* (Stephens, 1835) | |
| *Heptagenia sulphurea* (Muller, 1776) | XX |
| *Rhithrogena germanica* Eaton, 1885 | |
| *Rhithrogena semicolorata* (Curtis, 1834) | |
| **Family Leptophlebiidae** | |
| *Habrophlebia fusca* (Curtis, 1834) | X |
| *Leptophlebia marginata* (Linnaeus, 1767) | X |
| *Leptophlebia vespertina* (Linnaeus, 1758) | X |
| *Paraleptophlebia cincta* (Retzius, 1783) | X |
| *Paraleptophlebia submarginata* (Stephens, 1835) | XX |
| *Paraleptophlebia werneri* Ulmer, 1919 | |
| **Family Potamanthidae** | |
| *Potamanthus luteus* (Linnaeus, 1767) | |
| **Family Siphlonuridae** | |
| *Ameletus inopinatus* Eaton 1887 | |
| *Siphlonurus alternatus* (Say, 1824) | |
| *Siphlonurus armatus* Eaton, 1870 | |
| *Siphlonurus lacustris* Eaton, 1870 | |

# NORFOLK BOTANICAL REPORT FOR 1995.

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Last year our botanical survey of the regions of Norfolk ended where the N.Norfolk dunes join the cliffs at Hunstanton, so it seems sensible to start at that point and work southwards along the Wash Coast and the greensand outcrop.

The beaches of the Norfolk side of the Wash are largely of shingle from Heacham southwards past Snettisham to Wolferton. Beyond that they are mostly salt marsh divided from the land by recent earthen banks and behind these, intensively cultivated arable land. Botanically it is the Heacham to Snettisham area which is most interesting. This is also popular with tourists and there are acres of caravans wherever roads reach the sea, but these are soon passed and the natural habitats beyond are varied and rich. The shingle bank itself, in spite of bulldozing and heightening over the last few years following erosion by the sea, still supports fine plants of sea kale, *Crambe maritima* and a great deal of horned poppy, *Glaucium flavum*. In 1994 the rare Ray's knotgrass, *Polygonum raii* was also found on the seaward slope of the bank. On the landward side the shingle merges with sand and several of the tiny clovers are found, notably burrowing, *Trifolium subterranean*, rough, *T. scabrum*, knotted, *T. striatum* and least trefoil, *T. micranthum* while this year the narrow–leaved hemp nettle, *Galeopsis angustifolia* was spotted for the first time for nearly forty years. This is probably the true home of the hoary mullein, *Verbascum pulverulentum* which, in a good year, grows in hundreds.

Behind the sand and shingle are the wet grasslands, a few 'improved' as the agriculturalists say, but many still happily in a natural state with in places quantities of the now scarce grass–leaved vetchling, *Lathyrus nissolia*, the coastal hairy buttercup, *Ranunculus sarduous* and strawberry clover, *Trifolium fragiferum*. Dividing these meadows, some of which are still cut for hay, is a system of dikes which contain the delightful flowering rush, *Butomus umbellatus* both marsh and golden docks, *Rumex palustris* and *R. maritimus* and the lesser water plantain, *Baldellia ranunculoides* among their botanical treasures. Although the fields themselves are private property, they are crossed by at least one good footpath and at Snettisham part lies within the Coastal Park.

Inland the northern end of the greensand belt is narrow and largely ploughed or planted , but farther south the typical flora of its thin, acid soils can be seen on the remnants of the former heaths around Sandringham, now largely coniferised, and at North Wootton where birch has engulfed the former heather covered Ling

Common. Dry heath is also seen on the drier parts of the National Nature Reserves of Dersingham Heath and Roydon Common as well as at East Winch. Here the dry tracks support blood red patches of mossy stone crop, *Crassula tillaea*, and numerous tiny spring ephemerals, mostly dried away to nothing by the time the summer tourists arrive. Chaffweed, *Centunculus minimus*, one of the rarest of these annuals, fomerly on at least two sites still eludes us. The real riches of these heaths are, however, in their wet areas where the water tables remain high and bogs have developed. Amongst the birches of Ling Common, N.Wootton, the marsh violet, *Viola palustris*, rare in W.Norfolk can still be found together with bog pondweed, *Potamogeton polygonifolius* and bog myrtle, *Myrica gale*. At Dersingham and a few other wet heaths are some large areas of cotton grass, mostly the more common *Eriophorum angustifolium*, but also including haresfoot cotton grass, *E. vaginatum*, common only in the north of Britain and the rare broad–leaved species, *E. latifolium*. Where the sphagnum grows thick, bog St John'swort, *Hypericum elodes*, bog asphodel, *Narthecium ossifragum*, marsh gentian, *Gentiana pneumonanthe*, cranberry, *Vaccinium oxycoccus*, sundews, *Drosera* species and butterwort, *Pinguicula vulgaris* all thrive in this increasingly scarce and very fragile habitat. It is one which should never be walked through unnecessarily and it is probably pressure of feet that has lost us grass of parnassus, *Parnassia palustris* and the rarer bladderworts, *Utricularia minor* and *U. intermedia* from their chief site in the last twenty years. The greensand has its southernmost outcrop in the county at Shouldham Warren, another coniferised area but with some unexpected species surviving in ditches and tracks.

To the west of the greensand are heavier soils which still support ancient woodland as at Wolferton, Castle Rising and Reffley Woods and others farther south, but unlike the area's bogs which are almost all nature reserves, the woods are all private property and rarely accessible. These woods are well separated from the main woodland area of central Norfolk and are characterised by the occurrence of plants which need moisture and acidity such as golden saxifrage, *Chrysosplenium oppositifolium*, lily–of–the–valley, *Convallaria majalis*, wood sorrel, *Oxalis acetosella* and bluebells, *Endymion hyacinthoides*, as well as the typical orchids, early purple, *Orchis mascula* and greater butterfly, *Platanthera chlorantha* and a wide range of ferns.

By contrast with the heathlands of West Norfolk, those in the vicinity of Norwich and stretching north to the coast between Sheringham and Cromer are much drier, with few areas supporting bog plants. The two that do readily spring to mind are Buxton Heath south–west of Aylsham, and Beeston Bog on the outskirts of Sheringham. The last named, a County Council local nature reserve, is perhaps the jewel of them all, thanks largely to Ken Durrant and his team of conservation volunteers who have spent many winters now cutting and burning the encroaching

1. *Geophilus carpophaguis* a geophilomorph centipede that sometimes enters houses. ( R.E. Jones)

2. *Philoscia muscorum*, one of the common woodlice species. (R.E. Jones)

3. *Ommmatoiulus sabulosus* , an easily identified millipede (R.E. Jones)

4. *Phalangium opilio* (male), a common harvestman showing horned chelicerae. (R.E. Jones)

stands of gorse and controlling the bracken. The result it the only site in the county that can boast eleven species of orchids in season, and a count of some 5 to 6000 common spotted orchids, *Dactylorhiza fuchsii* flowering in the main area. The bog itself, rich in bog mosses, *Sphagnum* sp., and with two species of sundew, *Drosera* sp., is neverthless unique in overlying chalk which can be seen in the streambed running down the length of the common and resulting in such a rich mixture of calcioles and calcifuges as one would scarcely expect to find. It was here a few years ago that the stagshorn clubmoss, *Lycopodium clavatum* was rediscovered, not having been seen since the early years of the century. Had it been lurking under the gorse for 90 years? It is doubtful if mountain everlasting, *Antennaria dioica* will ever be refound now, though Nicholson in his 1919 Norfolk Flora had several sites for it and Pigott (circa 1902) recorded it on Roughton Heath Petch and Swann did not include it even under extinct species..

Buxton Heath is also an SSSI with an active team of volunteers, though here birch, *Betula* sp., is the problem, but big strides have been made to open up the bog/fen area. Again there tends to be a mixture of calcicoles and calcifuges, though the former element is not quite as prominent as at Beeston.

Fragments of the former vast areas of dry heath can still be found, frequently in woodland rides as in the Stody/Melton Constable area, but even as far south as some of the woods on the fringes of the former Mousehold Heath. There Racecourse Plantation, Thorpe St Andrew, has all three heathers, *Calluna, Erica cinerea* and *E. tetralix*, as well as trailing tormentil, *Potentilla anglica* and in damp hollows in the central ride, big patches of allseed, *Radiola linoides* and yellow sedge *Carex viridula* ssp *oedocarpa*. Most of what remains of Mousehold Heath itself could be better described nowadays as 'Mousehold Wood'. South of Norwich the heathland ended when it reached the boulder clay, though ling, *Calluna vulgaris*, may still be found as far south as Dunston Common.

The other main vegetational region in the east of the county is, of course, the Broads. A very large slice of the county with minimal access to the botanist, largely due to the difficulties of the terrain. In 1994 a visiting researcher into round leaved wintergreen, *Pyrola rotundifolia*, had to be escorted to a birch carr on Catfield Great Fen. It was fine once the carr had been reached, but to get to it it was necessary to wade through foot deep water through a dense bed of saw sedge, *Cladium mariscus*. This is a pattern for many of the fens in Broadland, and, though a boat might be easier for moving from site to site, struggling on foot is the only way to sus out the hidden gems. Though much has undoubtedly declined because of pollution, it is still possible to find drains filled with water violet, *Hottonia palustris*, frogbit , *Hydrocharis morsus– ranae* and water soldier, *Stratiotes aloides* as well hornworts, *Ceratophyllum*, water milfoils, *Myriophyllum* and the

many species of pondweed *Potamogeton*.

Though less widespread than formerly, there are still areas where the stately water parsnip, *Sium latifolium* rubs shoulders with the still tall, but more delicately–leaved water hemlock, *Cicuta virosa*. Milk parsley, *Peucedanum palustre* by contrast, is quite widespread in Broadland still, fortunately for the swallowtail butterfly, *Papilio machaon*, whose food plant it is, and can still be found in outlying sites such as Swangey Fen near Attleborough and Old Buckenham Mere as well as a few West Norfolk sites.

Perhaps understandably, several of the species mentioned above are on the national register of scarce plants, or in the Red Data Book, such as the fen orchid *Liparis loeselii* which is maintaining its hold in Broadland with a good deal of encouragement from the various statutary bodies responsible for wildlife conservation in Broadland. It would be a national tragedy if insufficient funding for coastal and internal flood defence works were to result in salt water inundation of the fragile Broadland ecosystem, thus destroying it for ever..

## NORFOLK SNAILS AND THEIR ASSOCIATES

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A recent study of garden snails showed that some had been reduced to liquid in which small maggots could be seen moving. A total of 675 strawberry snails (*Trichia striolata* Pfeiffer) were collected and whilst those not obviously infected were returned to the garden, over 400 were retained for emergence of suspected parasites. Since that year the garden population of these snails has stabilised with no apparent increase in numbers or outbreak of parasitism.

The emerging flies were not all parasites. The putrid liquid to which the snails had been reduced attracted many scavenging flies to also lay their eggs. In addition to the parasites, hymenoptera followed and these were assumed to be hyperparasites or parasites on the flies rather than the snails. The full list collected from the snails is given below:-

Parasites.

Sciomyzidae. This group contains flies parasitic on both land and freshwater snails. The usual parasite *Pherbellia cinerella* emerged from *Trichia striolata*.

Phoridae. Small flies of this family emerged. They are associated with carrion and decaying matter but some of the species have a parasitic role, e.g. *Megeselia pulicaria* on spider's eggs. (Evans 1969).
*Spinophora berggenstami*
*Megeselia brevicostalis*
*Megeselia ruficornis*
*Megeselia flavicans* - probably a scavenger
*Megeselia nigra* - probably a scavenger
*Megeselia pulicaria* - probably a scavenger

Psychodidae. "owl midges". *Philosepedon humeralis*. These tiny moth like flies were present in most collections as they are in many kinds of decaying material.

Sarcophagidae. Two species emerged which are present in many types of decaying material.
*Sarcophaga nigriventris*
*Sarcophaga setipennis* (in small numbers).

Anthomyiidae. A single specimen emerged. *Craspedochoeta pullula*.

Fannidae. The lesser house fly *Fannia canicularis* was present.

A total of 39 Hymenoptera were collected from the above specimens. These were species of the genera *Stilpnina*, *Aphaereta*, and *Aspilota*.

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# SOME NORFOLK SPIDER PARASITE RECORDS

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1. On eggs - Diptera

*Megeselia pulicaria* (Fallen) (Phoridae)

This fly lays its eggs in spider egg sacs where the larvae on hatching consume the spider eggs. Occasionally some young spiders survive and emerge, although few in number. The authors first found this species some years ago in Warwickshire, emerging from collected egg sacs. It had not been previously noted from this source. Subsequently it has been found in Norfolk in several locations. Specimens

have been reared from a rotting fungus.

• *Megeselia nasonii* (Malloch) (Phoridae)
This fly has a similar life history to the above species and sometimes both species emerge from the same egg sac. Egg sacs containing this and *Megeslia pulicaria* have been found in dark damp locations, e.g. under bark and in rotten tree stumps. The host spiders are probably *Robertus* or *Enoplognatha* species.

2. On eggs - Hymenoptera
• *Tromatobia oculatoria* Fab.
Occasionally present in spider egg sacs, usually several per egg sac.

• *Trychosis tristator* (Tschek)
This has been found only in the egg sacs of *Pisaura listeri* where it forms pink cocoons before emerging. It is common and present in 7-8% of the spider's egg sacs in areas surveyed by the authors..

• *Trychosis legator* (Thunberg)
There is a single record for this species from a folded leaf containing the spider *Xysticus ulmi* and its egg sac. All of the eggs had been eaten and the egg sac contained one cocoon of this parasite which seems to choose only this spider's egg sac.

• *Ischnurgops fragilis* Grav.
This has been found emerging from the egg sacs of *Agroeca* spiders. It is not uncommon.

• *Agasthenes varitarsus* (Gravenhorst)
A collection included one egg sac of a *Tetragnatha* spider. From this emerged the above parasite and on examination the egg sac contained two parasite cocoons. Only one specimen had emerged. Considering the small size of the egg sac there was probably only enough spider eggs to bring one to maturity. Rather a rare species which seems to specialise in *Tetragnatha* cocoons.

• *Ocymuris similis* Bmel.
Frequent in eggs sacs of *Enoplognatha* spiders, several larvae can be found in each egg sac which later pupate in dark brown cocoons.

3. On spiders and eggs
• *Zaglyptus varipes* (Gravenhorst)
In a folded leaf remains of both spider and eggs eaten by two larvae found in pupation.

. On spiders - Hymenoptera
*Acrodactala degener* Hal.
These parasites have been found living on the abdomen in a position where the spider cannot dislodge them. Usually on small spiders and in one collection two parasites were present on the same host. Only one survived to pupate in a four sided cocoon in the threads of the host's web.

*Polysphincta tuberosa* (Grav.)
This parasite also occurs on the abdomen of the spider. Only recorded on the spider *Araniella cucubitina*. Occasional.

*Schizopyga circulator* (Panzer)
This parasite was in a cocoon under loose bark near the remains of the host spider *Clubiona terrestris* Westring. It emerges in May

**Acknowledgements**
The assistance of Dr M. Shaw in determining some of these species is acknowledged.

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## CASUALTIES AT CLEY TO SALTHOUSE

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The storm of February 19th and 20th 1996 with severe gale force north-easterly winds combined with spring tides resulted in the overtopping and subsequent flattening of the shingle ridge between Cley and Kelling with the consequent severe flooding of Cley and Salthouse Marshes. A walk along the beach between Kelling and the east bank of Cley a few days later (February 24th) revealed large numbers of sunstars (*Croaster papposus* (L.)) and detached sea anemones (not identified to species), together with the remains of many broken up lobsters (*Homarus vulgaris*) cast up on the beach. This suggest that the storm must have created strong scouring effects on the sea bed just offshore. Numbers of these species were particularly numerous on the eastern half of this stretch. In at least one place the chalk base to the ridge was also uncovered.

# PERCH LAKE AT WESTWICK

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## Introduction

Perch Lake was visited by Robert Gurney between 1912 and 1914. He found a lake whose water was "singularly clear" and contained "an abundance of crustacea". The fauna, however, was remarkable for "the small numbers of species which it includes but also for a group of species which are, on the whole, of a distinctly northern distribution."

In the ensuing years the lake has undergone radical changes. The northern species of Cladocera have been lost. They were mostly weed dwellers and the lake has lost most of the macrophytes amongst which Gurney made his collections. The margins of the lake have been overgrown by *Rhododendron ponticum* L. which overhangs the shallow waters at the edges.

Besides the loss of macrophytes, or perhaps the cause of it, is the greatly increased turbidity of the water. No longer is the lake "singularly clear". It has the appearance of stirred up peat. This is caused by very large numbers of the green alga *Botryococcus braunii* Kuetzing.

Although the lake has lost much of its interest to the microzoologist it is fascinating for the algologist. It has a pH of 5.5 to 5.7 and is thus an acid lake in an area where lakes are neutral or mildly alkaline. As a result it has a diatom flora which is unique for the lowland lakes of Great Britain and the near continent.

## Physiography.

Perch Lake is the largest, (3.89 ha), and deepest of the five secluded lakes grouped together as the Westwick Lakes (Nat. Grid Ref TG 273274). It is fed by three underground springs in the sandy bottom of the lake (*pers comm.* John Alexander). The lake is divided into northern and southern halves by a partly submerged bank, which represents an old roadway across the valley.

The north end of Perch Lake has depths of between 2.3m and 3.3m in the centre. Beyond the causeway the depths increase to between 4.5m and 5.1m. Near the southern end adjacent to the outfall embankment the depth is 4.2metres. In both halves of the lake the bottom is sandy. There is some decaying plant matter near Decoy Pond but generally the bottom is very sandy with a fine sand on the lake bed. Gurney (1914) observed that the bottom of the northern half is "more or less muddy" but this is less so in 1995. The waters are acidic in the range of pH 5.5 to pH 5.7.

Perch Lake is currently used as a wildfowl refuge. From mid-June until mid-September about 1000 mallard raised on the estate are transferred to the lake for

growth and sport. These numbers are augmented naturally by wild teal, tufted duck, goldeneye, goosander and pochard. The duck are fed on fields adjacent to Perch Lake to facilitate later shooting and collecting. This limits the pollution affects of uneaten food and nutrient enrichment by fowl droppings in the lake waters. The duck are shot from mid-September until February. The wintering numbers of mallard are limited to about 100 birds.

The earlier descriptions of the Perch Lake show that there have been many changes over the last eighty years. There is little evidence of shoreweed *Littorella uniflora* (L.) Aschers, though recorded by Lambley in 1991 (*pers. comm.*), and none of the once extensive carpets of bog mosses *Sphagnum* spp. Marsh pennywort *Hydrocotyle vulgaris* L. is also absent. Gurney's records for amphibious bistort *Polygonium amphibium* L., common spike-rush *Eleocharis palustris* (L.) Roem & Schult, greater reedmace *Typha latifolia* L., bur-reed *Sparganium erectum* L., sweet flag *Acorus calamus* L. no longer hold. There are a few scattered clumps of soft rush *Juncus effusus* L. near the Decoy Pond. These appear to have been grazed by red deer.

The whole of Perch Lake is now dominated by invasive rhododendron trees. These clean out over the lake to beyond 5-6 metres and so effectively shade out other marginal species. English Nature have advised that the trees between the Decoy Pond and Perch Lake be cut back to stump level. This has opened up this area and it will be interesting to see whether or not marginal aquatic plants colonise these shallow waters. The overhanging rhododendrons do provide cover for duck which are reared on this lake from late June. Some willow and birch shrubs grow amongst the rhododendrons. In one place a beech tree grows on the lake edge.

**Invertebrate Fauna**

Occasional specimens of *Asellus meridianus* Racovitzia were collected in the north end of Perch Lake in detritus beneath the overhanging rhododendron trees at depths of 1 metre. Gurney (1914) recorded small numbers of *Asellus aquaticus* (L.) in the lake but since at that time only this species was thought to be present in the British Isles it was probably *Asellus meridianus*. (see Racovitza 1919).

In his paper Gurney (1914) noted *Corixa* as being common in the shallows, but he did not identify the species. A number of species have been identified in the current survey but at no stage can they be described as being common. *Corixa punctata* (Illiger), *Callicorixa praeusta* (Fieber), *Sigara nigrolineata* (Fieber), *Hesperocorixa Sahlbergi* (Fieber) and *Corixa panzeri* (Fieber) were noted.

Phantom midge larvae *Chaoborus crystallinus* (Deg). are common in the north end of Perch Lake. These larvae are known from a wide variety of types of still water from acid moorland pools (usually at low altitude) to strongly alkaline lakes. (Brindle 1962). *Chironomus* sp. blood worms were abundant in the north end of Perch Lake and these are probably linked with the caddis fly *Oecetis ochracea* (Curtis) which eats both chironomids and tubifex worms. The only other species

of caddis collected from the lake was *Mystacides azurea* L. It was found at depths of 1.5 metres at the Decoy end. Macdonald (1950) described the larva from a Scottish locality at depths of 0.3-4.5m on a substratum of sand and *Isoetes*. It was previously recorded by Claude Morley at Brandon between 1906-29. A number of *Ischnura elegans* Van der Linden. bluetailed damselfly were collected from Perch Lake but numbers of both larvae and adults were very small. The only water mite noted in the survey was *Piona carnea* C.L.Koch in the shallow regions..

No mayfly larvae were collected in the present survey yet Gurney (1914) recorded them as being "not uncommon". Gurney also reported unsuccessful attempts to stock the lake with *Gammarus pulex* (L.) and freshwater mollusca. The acidic conditions and very limited aquatic vegetation of Perch Lake are probably the critical factors in preventing the latter from successfully colonising the waters. Inspite of the presence of large numbers of duck no evidence of the fowl leech *Theromyzon tessulatum* ( O.F.Muller) was noted.

**Cladocera**

A careful search was made for Cladocera in the lake. Catches from the open water were made with an ordinary zooplankton net and with a finer net with an apperture of 30 µm capable of retaining small algae. In addition searches were made among littoral debris and in dredged mud. The mud was placed in a benthic cladocera trap known to be very effective from other sites and collections made of the mud cladocera which entered the trap. On 24th September a total of 35 Cladocera were recovered from the trap. They were all *Daphnia obtusa* Kurz. Peat taken from the roots of *Juncus effusus* gave a number of cladocera which floated to the surface of the sampling beaker. These were all *Daphnia obtusa*. The result was disappointing to say the least. Gurney (1914) noted this planktonic form as being "common in Perch Lake at a depth of 2m". In 1995 it was abundant in both Perch and Little Perch Lakes, whilst in September the authors noted its presence as "myriads in water".

Gurney (1914) also noted five species as occurring on the bottom amongst the weeds. They were unknown elsewhere in Norfolk. Whilst two species *Drepanothrix dentata* Eurens and *Rhynchotalona fulcata* Sars were found in extremely small numbers by Gurney he found the other three relatively common; *Acantholeberis curvirostris* Muller, *Alona rustica* Scott and *Chydrorus piger* Sars. In the current survey none of these species were collected. A single *Chydorus* was recovered from the mud near the summer house but this proved to be the common *Chydorus sphaericus* (O.F. Muller) and not the rare *Chydorus piger*.

**Algae**

In May the lake waters were found to be dominated by the Chrysophyte *Botryococcus braunii*. This was in colonies 25-100 µm diameter. Although numbers were not high (1750/ml) because of their size they represented most of the biomass in the lake. The gut of *Daphnia obtusa* in the lake was full of this alga which became bright orange during digestion.

Besides the *Botryococcus* the plankton of the lake contains some diatoms and occasional *Scenedesmus quadricauda*. (Turp) de Breb. The diatoms will be dealt with below. Attached to some of the roots were very poor growths of green filamentous algae. These included *Tribonema* sp. and *Stigeoclonium*. Water seeping from the lake into pools contained the interesting *Trachelomonas bernadinensis* W.Fischer em Defl.

The following diatoms were recorded. The numbers of species present (42 taxa) were low when compared to most Norfolk habitats.

*Achnanthes elliptica*. Schumann.
*Achnanthes helvetica*. (Hurst) Lange-Bertalot.
*Achnanthes minutissima* Kutz
*Achnanthes saxonica* Krasske in Hust
*Caloneis sublinearis* McCall
*Cymbella amphicephala* Naegeli ex Kutz
*Cymbella gracilis*. (Ehrenb) Kutz.
*Cymbella naviculiformis* Auersw
*Eunotia bilunaris* Lange Berttalot
*Eunotia exigua* (Breb ex Kutz) Rabenhorst
*Eunotia incisa* W.S. ex Greg
*Eunotia serra* var *diadema* (Ehrenb) Patr
*Frustulia rhomboides* var. *crassinervia* (Breb ex W.Sm) R.Ross
*Frustulia vulgaris* (Thwaites) De Toni
*Gomphonema accuminatum* Ehrenb
*Hantzschia amphioxys* (Ehrenb) Grunow
*Navicula cincta* Ehrenb
*Navicula digitoradiata* (Greg) Ralfs in Pitch
*Navicula ignota* Krasske
*Navicula mediocris* Krasske
*Navicula oblonga* (Kutz) Kutz
*Neidium iridis* var. *ampliatum* (Ehreb) Cleve
*Neidium productum* (Wm.Sm) Cleve
*Nitzschia capitellata* Hust
*Nitzschia gracilis* Hantsch
*Nitzschia palea* (Kutz) A.Sm
*Nitzschia paleaeformis* Hust
*Nitzschia recta* Hantzsch ex Rabenh
*Pinnularia appendiculata* (Ag) Cleve
*Pinnularia abaujensis (gibba)* (Pant) R.Ross
*Pinnularia abaujensis* var *linearis* (Hust) Patr.
*Pinnularia borealis* Ehrenb
*Pinnularia interrupta* W.Sm.
*Pinnularia subcapitata* Greg
*Pinnularia microstauron* (Ehrenb) Cleve

*Pinnularia subcapitata* var. *hilseana* (Jan ex Rabenh) O.Muller
*Pinnularia viridis* (Nitzsch) Ehrenb
*Stauroneis anceps* Ehrenb
*Stauroneis phoenicentron* (Nitzsch) Ehrenb
*Surirella amphioxys* W.Sm
*Surirella linearis* W.Sm.
*Tabellaria flocculosa* (Roth) Kutz

This diatom assemblage indicates that the water must be oligotrophic, acid and with a low content of electroytes. It would be more typical of the Alps or of high northern latitudes.

Several of the diatoms found are rare. The list has been compared to the British diatom check list (Hartley 1986) and one or two of the taxa may be new British records.

In the northern end of Perch Lake the few plants were covered with *Eunotia exigua*. This is a resistant diatom (Round 1993). Round gives it as Zone 1 "clean water in uppermost reaches of rivers" which can withstand strong acidification (Krammer & Lange-Bertalot 1991). Its presence in flowing water would give a Trophic Diatom Index (Kelly & Whitton 1995) of only 1 indicating an oligotrophic site free of pollution.

**Acknowledgements**
The authors would like to thank Dr R.K. Jones (Watermites) Norfolk, Dr I. Wallace (Caddis larvae) Liverpool Museum, Dr Alan Savage (Waterboatmen) University of Keele and Bernard Hartley (Diatoms) for confirmation and/or identification of species. Special thanks are due to Mr John Alexander and Mr Ian Garfoot for permission to visit Westwick and for guidance during the visits. English Nature commissioned this study.

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## MASSIVE MIGRATION OF PAINTED LADY BUTTERFLIES 1996

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The arrival of June brought in the first really hot days of summer, it also saw the arrival of a number of migrant insects. At Sheringham a few Painted Ladies were noted on the cliffs on June 1st. Each day the numbers increased until June 7th when they were everywhere. It was possible to count 40-50 in ten minutes all flying westwards in great haste. I received calls from Mundesley, Kelling, Wells and Titchwell all with the same story.

Clouded Yellows also arrived. One was seen at Morston on the marshes on June 9th and another on Beeston Common on the follwing day. Silver Y moths have also flooded the gardens and commons during the same period.

## *CALOPLACA LUTEOALBA*, A DECLINING SPECIES

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*Caloplaca luteoalba* (Turner) Th Fr is a species largely confined to elm trees (*Ulmus* sp.) and once fairly frequent especially in the eastern part of the British Isles. Lambley (1989) records it from 6 localities in Norfolk in the period 1970-1984 but with the loss of almost all of the mature hedgerows and parkland trees it is almost extinct in the county as in the rest of the British Isles. However, in a few sites it grows on trees other than elm such as maple (*Acer campestris*) and horse chestnut (*Aesculus* sp.). In Norfolk the remaining locality is at Hempnall where it grows on a roadside horse chestnut which is used for village notices. The occasional damage caused by fixing the notices may favour the species which often grows in wound seepage and other nutrient enriched tracks on trunks. It is a species targeted for recovery in the recently agreed UK Biodiversity Plan.

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# MOTHS OF HICKLING BROAD

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The seasons of 1993, 1994 and 1995 since the publication of my original list (Moths and Butterflies of Hickling Broad. *Norfolk & Norwich Nats. Soc. Occasional Papers* **No 4.**, 1992.) have provided further observations and new records.

**New species:**

| | | |
|---|---|---|
| 449 | *Prays fraxinella* | associated with ash, windblown from nearby woodland. |
| 1292 | *Calamatropha paludella* | a long awaited record, of a "Notable B" status moth. Easily confused with the macro *Chilodes maritimus*; the Silky Wainscot. The long pyralid labial palps are helpful diagnostic features. The larva is a *Typha* feeder. |
| 1484 | *Phycitodes saxicola* ) | |
| 1485 | *Phycitodes maritima* ) | awaiting precise determination. |
| 1748 | *Mesoleuca albicillata* | Beautiful Carpet. |
| 1962 | *Hylaea fasciara* | Barred Red, first record 20 July 1993. |
| 1987 | *Hyles gallii* | Bedstraw Hawk, a scarce migrant noted 17. July 1993. |
| 2033 | *Lymantria monacha* | Black Arches. Two males, 18-20 July 1995. Known from other Norfolk woodland. |

With the increasing interest in pyralids, reference to Parson's *Review of scarce and threatened pyralid moths of Great Britain* ( published by JNCC 1993), shows the importance of Hickling as an entomological site.

In the scarcest category Rare, *Platytes alpinella* comes to light, is of annual occurrence, and is a well established local resident. Parsons suggests that with increasing knowledge of the status of this moth it should be down graded to Notable A ( 30 or fewer 10km squares nationwide). Already in this category is *Nascia cilialis*, frequent at Hickling in late July; *Phlycytaenia perlucidalis*, known from Hickling twenty years ago and now spreading widely in East Anglia.

Of Notable B status an outstanding broadland speciality is *Schoenobius gigantella* which with *Eudonia pallida*, *Crambus pratella* and the intermittent colonist *Anclyosis oblitella* are restricted to between thirty one and one hundred 10 km squares.

There remains a continuing challenge and excitement at looking at this small group.

# COLEOPTERA OF HOLKHAM NATIONAL NATURE RESERVE, NORFOLK

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## Introduction

Holkham National Nature Reserve is situated on the North Norfolk coast and covers an area of some 3887 hectares between Burnham Norton in the west and Blakeney in the east. However, to the east of the Warham saltmarsh it is only the foreshore and creeks that lie within the reserve boundary, thus Stiffkey saltmarsh and other areas of this habitat-type to the east are not included in the reserve and are the property of the National Trust. Some large areas of arable land, particularly just to the west of the Wells beach road and at Burnham Overy were originally included in the reserve but have recently been de-declared.

The reserve is divided into two sections by the Wells Channel. The section to the east comprises primarily extensive saltmarsh and intertidal mud and sandflats, with the exception of an isolated pocket of sand dunes and conifers (*Pinus* species) on the East Hills immediately east of the channel and north of Lodge Marsh. A greater variety of habitat-types lies to the west of the channel and includes intertidal mud and sandflats, sand dunes, a belt of predominantly *Pinus* woodland, dune scrub and deciduous woodland, saltmarsh (small areas at Burnham Overy and Burnham Norton), reclaimed grazing pastures, arable land, and drainage dykes associated with the pastures and arable land. There are approximately 400 hectares of permanent grassland and since water levels were first raised by about a metre in 1986, much of this is now very wet in winter and some 5 per cent is permanently flooded. A detailed account of the reserve is given by Harold (1994).

The only previously published account of the beetle fauna of a North Norfolk coastal site is that of Welch (1982 & 1986) concerning Scolt Head National Nature Reserve. At the time of writing a total of 513 species from 47 families have been recorded from Holkham NNR and these are listed in Appendix 1. Nomenclature follows Kloet & Hincks (1977) but subsequent taxonomic changes have been taken into account.

English Nature have kindly agreed to produce the complete species list with full collecting details, and copies will be available direct from the author. Copies will also be lodged in the Norfolk Biological Data Bank, Castle Museum, Norwich; English Nature Norwich, and with the Invertebrate Site Register the Joint Nature Conservation Committee in Peterborough.

## Literature References to Holkham Coleoptera

The earliest mention of beetles for what is now the reserve area seems to be that of J.Dawson (1858) where he says that *Cicindela maritima* "Is found in immense profusion near Burnham Market." Whilst the exact locality is not given this statement could refer to either the Burnham Overy or Holkham sand dunes. Next

comes Fowler (1887-1891) who records *Bledius atricapillus* and *B.taurus* (now *B.furcatus*) at Wells. Later, in Fowler & Donisthorpe (1913), *B.diota* is recorded as abundant at Wells on the authority of J.A.Brewer, and also as having been taken there recently by Professor H.Beare, H.Donisthorpe and Dr.N.H.Joy. According to Edwards (1914) Brewer took *B.diota* at Wells in 1867. A note by Joy (1903) records *Hydnobius perrisa* (now *Trichohydnobius suturalis*) and *H.punctatissimus* (now *H.punctatus*) on the sandhills at Wells in October 1902. In Joy (1904) *Bledius arenarius* (now *B.fergussoni* ), *B.bicornis, B.fuscipes, B.spectabilis, B.subterraneus, B.taurus. Dyschirius salinas, D.thoracicus* and *Heterocerus femoralis* (now *H. flexuosus)* are all recorded from Wells Marshes in August 1904, although at least *Bledius taurus* was clearly taken close to the dunes fringing Lodge Marsh. In a postscript to the paper by Edwards (1905), C.Morley records from Wells on the authority of Joy three of the species mentioned by him, and also includes *Tachys scutellaris* which Joy (1904) did not mention.

In Ellis (1940) is a record of *Orthocerus clavicornis* found under the lichen *Peltigera canina* in a damp sandy place under the pines at Wells during a British Empire Naturalists' Association excursion on 17th February 1939.

More recently, Barham (1961) recorded *Leistus rufomarginatus* from the Holkham pinewoods on 25th July 1958 and 1st August 1961. R.Crossley (1980) noted many *Malachius barnevillei* at Burnham Overy Staithe in June 1976, and in June 1977 took *Bledius spectabilis* and *B.unicornis* there. The presence of *Leptura rubra* at Holkham is reported by Mendel (1982) who states that H.Henson found it to be quite numerous there in July and August 1952.

The distributional atlas of the Cryptophagidae-Atomariinae (Johnson 1993) lists records of *Atomaria munda* and *A.rhenana* taken at Wells by N.H.Joy, but it has not yet been possible to ascertain whether or not the site where they were taken is within the NNR. A computer print-out of Norfolk *Atomariinae* records provided by the Biological Records Centre lists *A. testacea* as having been taken at Wells-next-the-Sea post-1960 by S.A.Williams.

**Species Not Recorded Since 1959**

There are 21 species in this category of which 7 have not been recorded since the beginning of the century. Four of these are Staphylinid beetles in the genus *Bledius* and the most interesting is *B.furcatus*. As mentioned above, this species was noted from Wells by Fowler (1887 - 1891) who classed it as rare. However, Joy (1904) states that in August 1904 he found some 40 specimens, but in 1909 H.Donisthorpe took just one specimen. It is not clear whether Joy actually collected all the 40 specimens that he found, or if Donisthorpe saw more than the one he collected. The site was visited by E.C.Bedwell in 1914 and the list of captures in his diary does not include *B.furcatus*. It would seem that the species became extinct at Wells some time after 1909, and a number of coleopterists have searched for it in recent years without success.

The presence of *B.atricapillus* at Wells is also mentioned by Fowler (1887 -1891) but unfortunately no dates are given. The remaining two species in this genus - *B.fuscipes* and *B.subterraneus* - taken by Joy in August 1904 have not been found since. Another record dating from August 1904 is the Carabid *Tachys scutellaris* which, according to Morley (in Edwards 1905) Joy took at Wells in conjunction with *Bledius fergussoni* and *B.bicornis*. This was apparently the first record for Norfolk and it is curious that it was not mentioned by Joy (1904).

Two species of Leiodidae were taken in the sandhills at Wells in October 1902 (Joy 1903), these were *Trichohydnobius suturalis* and *Hydnobius punctatus* and neither have been found since. E.C.Bedwell in his diary for July 1914 records the capture of *Meligethes fulvipes* and *M.obscurus* (Nitidulidae) at Wells. These remain the only records. The two water beetles taken in 1922 by C.T.Gimmingham - *Gyrinus marinus* and *Octhebius nanus* have not been found since. These records originate from notes made on a Balfour-Browne MS and no further details are given.

On 17th February 1939 (Ellis 1940) a specimen of *Orthocerus clavicornis* (Colydiidae) was taken and remains the only record. Seven species taken in the 1950s have not been recorded since. Three of these were collected by H.Henson on 23rd August 1952. The Carabid *Cicindela maritima* was flying in the dunes and it is thought that a colony existed there. The fact that it has not been seen since may be connected with the major floods of 1953. The other two species were *Anatis ocellata* and *Harmonia quadripunctata* (Coccinellidae) which were both obtained by beating pines. The same collector visited Holkham again on 3rd August 1956 and took *Pissodes castanea* and *P.pini* (Curculionidae) on pine trees, and *Hylastes ater* (Scolytidae) in the bark of a pine. The final species is *Corticaria punctulata* (Lathridiidae) taken on Warham saltmarsh by Andrew Foster on 14th August 1985.

**Scarce and Threatened Species**

The publication of Hyman & Parsons (1992 & 1994) has laid the foundation for the recognition of those species of Coleoptera which are scarce or threatened in Britain, including those which qualify for Red Data Book (RDB) status. On this basis 61 of the species recorded for Holkham NNR qualify for inclusion in one of six categories, and these are identified in appendix 1.

**A Taxonomic Note**

When referring to the list of species recorded at Holkham it should be borne in mind that since the publication of Kloet & Hincks (1977) several long-established species have been found to comprise more than one species in recent years. The carabid *Calathus melanocephalus* was split in 1989 into *C.melanocephalus* and *C.cinctus* Motschulskv. Both are widespread in their distribution and the Holkham records of the former, all of which are pre-1989, will have to be checked in this context. The same situation prevails in respect of another carabid, *Pterostichus nigrita* which, in 1986, was split into *P.nigrita* and *P.rhaeticus* Heer. Once again, both species are widespread in Britain and the Holkham specimens, particularly those taken in pitfall traps in wet pasture, will have to be re-examined. Even more

recently the chrysomelid *Oulema melanopus* has been split into *O.melanopus* and *O.rufocyanea* (Suffrian). There are five Holkham records of the former by three different collectors which now require re-evaluation.

## HABITATS

### Saltmarshes

A total of 115 species have been recorded from this habitat-type on the reserve. Many of these have no particular association with saltmarshes and are of purely accidental occurrence there, some as wanderers from adjacent habitats. An interesting example of a non-saltmarsh species being found in large numbers is the ladybird *Coccinella 7-punctata* of which thousands both dead and alive were present on 12th and 13th August 1994, all along the coast from Burnham Norton to Warham saltmarsh; part of a large scale migratory movement.

Saltmarshes, sandy and muddy shores, sand dunes, and shingle beaches each have their characteristic types of beetles Sandy or muddy shores may grade into saltmarshes which, like the shores, have their own characteristic fauna and flora which are regularly covered by seawater at high tides, and it is these areas which are the habitat of the most characteristic saltmarsh beetles. There is a faunal zonation and the greatest diversity of species are usually found in the areas where there is flooding by periodic spring tides, that is to say the upper saltmarsh. Other species such as some members of the genera *Bledius, Cillenus, Dicheirotrichus* and *Heterocerus* are effectively confined to the upper regions of banks and drainage channels where rapid run-off ensures that the burrows and cracks which they occupy do not become waterlogged (see Evans *et al* 1971). Many species of beetle not confined to saltmarshes or even to coastal areas are often found in the transition area between the saltmarsh and terrestrial habitats. It is thus difficult to define exactly which are true saltmarsh species. At Wells-next-the-Sea, Lodge Marsh which lies just east of the main channel grades into the sand dune habitat on the south side of the East Hills. The masses of detritus which accumulate along the high water mark of normal tides, which is thrown onto the higher parts of the saltmarsh by the periodic spring tides, is also a good source of adventitious beetles and the preferred habitat of some other species. Regrettably, the published information on the invertebrate fauna of saltmarshes is very inadequate, and in some cases is neither complete or entirely accurate. Cooter & Cribb (1975) list 37 species of beetle under the heading saltmarshes, but a number of these, particularly the Tenebrionidae, are certainly not true saltmarsh species in my experience. Alan Stubbs in Fry & Lonsdale (1991) states that 106 species are resident on saltmarshes and 47 of these are exclusive to that habitat. Unfortunately this statement is unsupported by either lists or references

Analysis of the species reveals some interesting points. Only 32 of the species listed can be regarded as saltmarsh specialists. Four of these species are associated with particular saltmarsh plants - *Apion limonii* with the sea lavenders *Limonium* species *Gronops lunatus* with the sea spurreys *Spergularia* species; *Longitarsus plantagomaritimus* with sea plantain *Plantago maritima*, and *Polydrosus pulchellus*

5. Sea lavender in bloom on Norfolk saltmarsh. (B. Sage)

6. Sand dune plants at the East Hills, Wells, Norfolk. (B. Sage)

7. Dyke and damp pastures, Holkham West NNR. (B. Sage)

8. Natterjack toad habitat, Holkham. (B. Sage)

with sea wormwood *Seriphidium maritimum*. Three further species associated with saltmarsh plants have been recorded at Holkham but not from this habitat. The weevil *Mecinus collaris* normally found on sea plantain has been taken on driftwood on the beach at Burnham Overy; the weevil *Phyllobius vespertinus*,usually associated with sea wormwood has been taken by sweeping on Burnham Overy sea wall adjacent to saltmarsh, and *Phaedon concinnus* (a chrysomelid), usually associated with scurvy-grasses *Cochlearia* species or sea arrowgrass *Triglochin maritima* has been found in the sand dunes and saltings debris at Burnham Overy. A few species seem to have a preference for the sand-saltmarsh zone of intergradation or sandy areas within the saltmarsh and these include the anthicid *Anthicus constrictus*, the carabids *Dicheirotrichus gustavi* and *Panageus bipustulatus*, the staphylinids *Bledius bicornis, B.fuscipes, B.germanica* and *B.subniger*, and the weevil *Gronops lunatus*. This was found under sea-heath *Frankenia laevis* that was growing in that habitat.

There are 45 mostly non-saltmarsh species whose occurrence in that habitat rests solely on specimens found in saltings debris. Among these species *Atheta vestita* is in fact normally found in tidal refuse; *Corticaria crenulata* is also found in vegetable refuse and detritus and is primarily a coastal species; *Dicheirotrichus obsoletus* is an inhabitant of the tidal zone; and *Aleochara grisea, Cercyon littoralis, Halobrecta algae, Heterothrops binotatus* and *Omalium riparium* are all usually found under seaweed on the shore.

**Sand Dunes**

The sand dune habitat includes areas of unstable and shifting sands, stabilised dune systems with, amongst other species, marram *Ammophila arenaria* and lyme-grass *Leymus arenarius*, and dune slacks some of which are damp for most of the year. A total of 114 species have been recorded from this habitat-type. Within this total are 19 species characteristic of this type of habitat, but only 5 of these can be regarded as virtually confined to sand dunes - *Cicindela maritima, Harpalus servus. Phylan gibbus, Psylliodes marcida* (on sea rocket *Cakile maritima*) and *Trichohydnobius sulcuralis*. Five of the species have also been found on the open shore and these are *Aegialia arenaria , Bembidion aeneum, Bledius fergussoni, Broscus cephalotes* and *Cafius xantholoma* . Most of these were taken on the upper shore and reflect the transition from open shore to sand dune. Whilst not particularly characteristic of sand dunes there are 6 species that are distinctly coastal in their distribution and these are *Coccinella 11-punctata, Dyschirius salinas, Harpalus anxius, H.vernalis, Staphylinus ater* and *Tachys scutellaris*. Mention must be made of the chrysomelid *Cassida vittata* which is usually found on sea sandwort *Honckenya peploides*, a common plant of the dunes at Holkham. This species has so far not been found in this habitat, but has been recorded in saltmarsh detritus.

As is the case with the saltmarsh habitat, the great majority of the species recorded in the sand dunes are of purely accidental occurrence there, some as wanderers from adjacent habitats.

## Shores

Along the coastline of the Holkham NNR muddy or sandy shores grade into sand dunes or saltmarshes, and a total of 27 species (13 of them of accidental occurrence) have been recorded from this specialised habitat.

Fourteen of these species are characteristic members of the shore invertebrate fauna but *Pselactus spadix* which was found under driftwood, normally occurs in old posts chiefly on the seashore, but also elsewhere. Four species - *Aegialia arenaria*, *Anotylus maritimus*, *Broscus cephalotes* and *Cafius xantholoma* - also occur in sand dunes, but *A.maritimus* has not so far been found in the Holkham dunes. The ground beetle *Dyschirius impunctipennis* is a predator on the staphylinids of the genus *Bledius* which inhabit fine sands on the seashore, and at Holkham it has also been found in sandy situations on the saltmarsh and in the sand-saltmarsh zone of intergradation. The histerid *Hypocaccus metallicus* which has been found under driftwood on the shore is normally associated with dung or carrion in coastal sandhills, and has been found in the sand dunes of the NNR. It may be noted that the dung beetle *Aphodius foetidus* is mainly a coastal species.

It is interesting to note that four species of the Carabid genus *Bembidion* which are characteristic seashore species - *B.ephippium*, *B.laterale*, *B.minimum* and *B.normannum* - have not been taken on the shore in the NNR, but all have been recorded on the saltmarsh.

The dung beetle *Aphodius contaminatus* was swarming on and over the beach at Wells on 24th September 1992, and there were reports of large numbers also being seen at Burnham Overy. The staphylinid *Anotylus sculpturatus* was abundant on the upper shore and on the seaward edge of the sand dunes at Burnham Overy on 21st October 1995.

## Dykes and Pools

The aquatic non-marine habitats at Holkham primarily comprise an extensive network of drainage dykes, but also some permanent pools, areas of permanently flooded grassland where the extent of water may vary quite considerably, and a few ephemeral grassy pools which form in pastures. One of the permanent pools is situated within the pinewood where it is shaded and contains decaying pine needles and leaves. The only species of water beetle so far recorded from this site is *Hygrotus inaequalis*. Close to the landward edge of the sand dunes just west of the pinewoods are a small group of pools on sandy pasture, and these are a habitat for Natterjack Toad *Bufo calamita*. In extended dry periods the water levels in these pools drop considerably and they may dry out altogether. There is also a small shallow lake siutated between the pine-covered sand dunes and grassland reclaimed from pre-existing saltmarshes. This is known as Salts Hole and is very saline with a relict marine fauna, and no water beetles have been recorded there. It is described in detail by Hunt (1971). Some of the dykes are also saline to a varying degree but no detailed survey to establish the number and location of these has been carried

out. Some of the dykes near the sea walls at Burnham Overy and Burnham Norton are probably saline, as is at least one dyke to the east of Meals House. There are several saline dykes in arable land just to the west of the beach road at Wells-next-the-Sea. This arable land and a further area at Burnham Overy were formerly included in the reserve. Rotational dyke clearing is carried out on a 7 year cycle which influences recolonisation by both the flora and invertebrates.

The water beetle fauna of the permanently flooded areas of grassland has been little investigated, but a considerable amount of work has been done on the dykes and pools over a period of years, including detailed surveys of 18 dykes within the NNR by R.J.Driscoll in August and September 1975 and 15 dykes at Holkham by Dr A.C.Warne in September and October 1988. The water beetle fauna of the NNR comprises a total of 77 species in eight families as follows:

*Dytiscidae* (29) *Elmidae* (1) *Gyrinidae* (3) *Haliplidae* (8)
*Hydraenidae* (6) *Hydrophiidae* (28) *Hygrobiidae* (1) *Noteridae* (1)

There are 10 species that are adapted to brackish water conditions. The species concerned are:

*Agabus conspersus*
*Coelambus parallelogrammus*
*Enochrus bicolor**
*Enochrus halophilus*
*Enochrus melanocephalus**
*Gyrinus marinus**
*Gyrinus substriatus*
*Haliplus apicalis**
*Octhebius auriculatus**
*Octhebius marinus*

* Single records only

Given the lack of data on the number and location of saline dykes on the reserve, most of the records of these species cannot be related to this factor. One species, *Gyrinus substriatus*, is not confined to brackish water conditions but occurs also in fresh and peaty waters. It is known from 6 dykes on the reserve of which only one is known to be brackish. Another species of this genus, *Gyrinus marinus*, has the same habitat preferences, but there is no evidence as to where on the reserve this beetle was taken. There are 5 records for *Agabus conspersus* at least 4 of which are from non-brackish sites, including a dune pool and a temporary grassy pool in a pasture. The records for *Enochrus bicolor* and *E.halophilus* are from brackish dykes with the exception of one for the latter species which was in a grassy pool adjacent to a brackish dyke.

For 19 of the remaining species there are single records only:

*Coelostoma orbiculare*
*Copelatus haemorrhoidalis*
*Dytiscus circumcinctus*
*Dytiscus marginalis*
*Elmis aenea*
*Hydroporus tessellatus*
*Hydroporus tristis*
*Hygrobia herrmanni*
*Ilybius ater*
*Ilybius fenestratus*

*Enochrus coarctatus*
*Haliplus flaviollis*
*Helophorus aequalis*
*Heleophorus granularis*
*Heleophorus griseus*
*Ilybius quadriguttatus*
*Limnebius truncatellus*
*Limnoxenus niger*
*Ochthebius dilatatus*

Four of these records are worth comment, using Friday (1988) as a guide to habitat preferences. *Elmis aenea* is said to be a species of running water in riffles, but the Holkham record is from a deep dyke with common reed *Phragmites australis* and negligible flow. The habitat for *Coelostoma orbiculare* is given as damp places in fens and moss, but the Holkham record is from a dune pool. In the case of *Limnoxenus niger* the habitat is given as fen drains, but at Holkham it was found in a grassy pool in a pasture. Finally, *Hygrobia herrmanni*, a species of silt and detritus ponds, was taken in a dyke by permanent pasture.

On the basis of existing records there are 12 species which can be regarded as common (recorded from 10 or more sites) on the NNR.

*Agabus bipustulatus* (12)
*Anacaena limbata* (15)
*Graptodytes pictus* (17)
*Haliplus ruficollis* (25)
*Haliplus lineatocollis* (13)
*Helophorus minutus* (13)
*Hyphydrus ovatus* (12)
*Hydroporus palustris* (25)
*Hydroporus planus* (12)
*Hygrotus inaequalis* (23)
*Laccophilus minutus* (16)
*Noterus clavicornis* (19)

The above table includes data from Burnham Norton where three dykes examined to date have yielded a total of 19 species. Only one of these *Copelatus haemorrhoidalis* taken on 6th May 1993 has not been found also at Holkham or Burnham Overy.

The three highest scoring dykes, with 24, 26, and 27 species respectively, are all in close proximity in pasture near Meals House.

**Species Associated With Dyke Flora**

The vegetation of 38 dykes at Holkham was studied in 1975 and the results of this research were later published (Driscoll 1986). This survey included some highly saline dykes that drained areas of arable land which were subsequently excluded from the NNR. Two major vegetation types (species-rich and species-poor) were identified, and these were divided into 5 distinct vegetation classes which differed from each other both qualitatively and quantitatively. The 6 highly saline dykes had an impoverished flora of brackish water species of which only common reed *Phragmites australis* and *Enteromorpha* species were widely distributed. A further 7 dykes had a slightly richer flora of typical brackish-water species of which only common duckweed *Lemna minor*, common reed and *Enteromorpha* species were widely distributed. Nearly all of these species-poor dykes were associated with arable land. A total of 17 species of beetle have been found on plants growing in dykes with a species-rich flora, but 5 of these (*Adalia bipunctata*, *Anthonomus*

*rubi*, *Coccinella 7-punctata*, *Longitarsus jacobaea* and *Sitona lineatus*) are of accidental occurrence and have no specific connection with aquatic plants. One of the remaining 12 species, *Cyphon variabilis*, is characteristic of marshy habitats but is not confined there, one example was swept from aquatic vegetation on 25th May 1990. The weevil *Litodactylus leucogaster* occurs on a variety of aquatic plants and one was swept from a dyke near Meals House on 5th July 1993. Similarly, *Anthocomus rufus* occurs on various aquatic species and on the NNR has been taken in common Reed and reed sweet-grass *Glyceria maxima*. The remaining 9 species have been found on their known host plants:

| Plant | Beetle |
|---|---|
| *Epilobium hirsutum* | *Altica lythri* |
| *Equisetum fluviatile* | *Hippuriphila modeeri* |
| *Glyceria maxima* | *Donacia simplex* |
| *Lythrum salicaria* | *Galerucella pusilla* |
| | *Nanodes marmoratus* |
| *Mentha aquatica* | *Datonychus melanostictus* |
| *Rumex hydrolapathum* | *Galerucella sagittaria* |
| *Veronica beccabunga* | *Phaedon armoraciae* |
| | *Prasocuris junci* |

**Bare Mud by Dykes and in Wet Pastures**

A total of 18 species have been recorded in this habitat:

| | |
|---|---|
| *Aleochara lanuginosa* | *Heterocerus fenestratus** |
| *Bembidion articulatum** | *Loricera pilicornis** |
| *Bembidion bruxellense** | *Philonthus cognatus* |
| *Bembidion genei** | *Philonthus laminatus* |
| *Bembidion properans* | *Philonthus quisquilarius** |
| *Bembidion saxatile* | *Philonthus varius* |
| *Bembidion varium** | *Platystethus cornutus** |
| *Cercyon marinus** | *Platystethus nitens** |
| *Elaphrus riparius** | *Platystethus nodifrons* |

* species characteristic of this habitat

Seven of the above species have no particular connection with this type of habitat and can be considered of accidental occurrence there. One of these species, *Bembidion saxatile*, is usually found on gravel at the edge of water and also on the seashore, but the only record for the NNR is from mud by a dyke at Burnham Norton on 16th April 1993. The staphylinids *Aleochara lanuginosa* and *Philonthus laminatus* are normally found in dung etc. Among the 11 species typical of this habitat-type, *Bembidion bruxellense* is eurytopic and is found on all kinds of moist ground with sparse vegetation, and *B.varium* is primarily a saltmarsh species but does also occur near freshwater. Among the other carabids recorded, *Elaphrus riparius* is strongly hygrophilous and is a common species in the present habitat, as

is *Loricera pilicornis*. Among the 3 staphylinids characteristic of this habitat *Platystethus nitens* is also sometimes found under bark.

**Damp and wet pastures**

A common habitat-type on the reserve from which 12 species have been recorded, of which only 3 are particularly associated with damp-wet conditions:

*Agonum marginatum**
*Agonum muelleri*
*Bembidion aeneum*
*Loricera pilicornis**
*Nebria brevicollis*
*Platydracus pubescens*
*Pterostichus nigrita**
*Quedius fuliginosus*
*Staphylinus aeneocephalus*
*Tachyporus chrysomelinus*
*Tachyporus hypnorum*
*Xantholinus longiventris*

* species characteristic of this habitat

Most of the above species were taken in pitfall traps in which *Loricera pilicornis* was commonly recorded. One of the other Carabids. *Agonum marginatum*, normally frequents the margins of lakes and ponds, soft wet clay or sand, and may also occur on seashores. At Holkham it has proved to be a common inhabitant of the wet pastures.

**Grass Litter**

This habitat has provided records of 10 species of beetle only 5 of which (marked * below) are typical of this medium:

*Anthicus formicarius**
*Aridius nodifer**
*Atheta xanthopus**
*Atomaria lewisi*
*Autalia longicornis*
*Bembidion aeneum*
*Cryptophagus pseudodentatus**
*Metopsia retusa**
*Stilbus testaceus*
*Tachyporus pusillus*

It may be noted that *Autalia longicornis* is usually found in fungi.

**Trees and Shrubs**

The extensive conifer woodland on the Holkham dunes consists of Corsican pine *Pinus nigra* ssp. *laricio*, maritime pine *P.pinaster* and Scots pine *P.sylvestris*. Associated species, primarily found along the landward edge, include holm oak *Quercus ilex*, pedunculate oak *Quercus robur*, silver birch *Betula pendula*, sycamore *Acer pseudoplatanus*, wild cherry *Prunus avium*, willows *Salix* species and holly *Ilex aquifolium*. There is also a linear open plantation of poplars *Populus* species. Shrubs present include broom *Cytisus scoparius*, elder *Sambucus nigra* and hawthorn *Crataegus monogyna*.

A total of 24 species have been recorded on pine trees on the reserve. Twelve of these species have no particular association with pine trees and need not be considered further. However, it is of interest to note that *Loricera pilicornis* was

found under bark on 24th August 1980, and *Glischrochilus hortensis* has twice been taken at sap. The staphylinid *Quedius lateralis*,which was also found under bark on 24th August 1980, is usually associated with decaying fungi. The 3 species not confined to pines includes one, *Leptura rubra* which, although normally found on fir or pine stumps, occasionally occurs on oak and beech. There are 5 species that are particularly associated with Scots pine and these are *Anatis ocellata, Arhopalus rusticus* (usually in stumps), *Harmonia quadripunctata, Hylastes ater* (in bark) and *Myrrha 18-guttata*. It may be noted that Kennedy & Southwood (1984) state that 37 species of phytophagous beetles are associated with Scots pine in Britain. Pedunculate oaks have yielded only 7 species:

*Anaspis regimbata*
*Coeliodes erythroleucos**
*Curculio pyrrhoceras**
*Curculio salcivorus*
*Phyllobius pyri*
*Propylea 14-punctata*
*Rhynchites aeneovirens**

* species usually confined to oak

It can be seen that only 3 of these species are closely associated with oak, while *Curculio salicivorus* is normally found on willows. The remaining 3 species can be regarded as accidentals. The small number of species recorded on oaks in the NNR is hard to explain, particularly since Kennedy & Southwood *op cit* give 67 phytophagous beetles as being associated with oaks. Silver birch has provided only one species, *Deporaus betulae*, whilst Kennedy & Southwood *op cit* say that 7 phytophagous species are associated with the two species of birch in Britain. Similarly, only the longhorn beetle *Saperda carcharias* has been recorded from the poplars (on 24th August 1984). The occurrence of this beetle at Holkham is interesting and it is the most recent Norfolk record. Previous records for the county have all been from the Broads area, so possibly the Holkham specimen is an immigrant from the Continent. Five species have been recorded from willows:

*Chalcoides aurata*
*Chalcoides aurea*
*Chalcoides fulvicornis*
*Dorytomus dejeani*
*Dorytomus rufatus*

and all except one are known to be associated with these trees, the exception being *Dorytomus dejeani* which is usually found on aspen *Populus tremula*. A specimen of the weevil *Magdalis armigera* was beaten from dead branches of elm *Ulmus* species on 31st May 1993.

As so far as shrubs are concerned, 6 species have been taken on broom only one of which (* below) is restricted to this species:

*Adalia bipunctata*
*Bruchidius villosus**
*Calvia 14-guttata*
*Coccinella 7-punctata*
*Myrrha 18-guttata*
*Stilbus testaceus*

The situation is very little different in the case of hawthorn from which 13 species have been recorded, only 2 of which (* below) are usually restricted thereto:

*Anaspis maculata*
*Bruchus rufimanus*
*Cantharis cryptica*
*Cychramus luteus*
*Dolopius marginatus*
*Dromius linearis*
*Grammoptera ruficornis*
*Lochmaea crataegi**
*Otiorhynchus clavipes*
*Pyrochroa serraticornis*
*Rhagonycha femoralis*
*Rhynchites aequatus**

**Non-saltmarsh or Dyke Plants**

Six species of herbs have provided records of 10 species of beetle all of which are known to occur on the plants in question:

| Plants | Beetles |
|---|---|
| *Lotus corniculatus*: | *Apion loti* |
| | *Meligethes erythropus* |
| *Malva sylvestris:* | *Apion malvae* |
| | *Apion radiolus* |
| | *Apion rufirostre* |
| *Cirsium arvense:* | *Apion carduorum* |
| | *Crepidodera ferruginea* |
| *Heracleum sphondylium:* | *Phaedon tumidulus* |
| *Plantago lanceolata:* | *Gymnetron pascuorum* |
| *Solanum dulcamara:* | *Pria dulcamarae* |

**Fungi**

Much more work on this aspect needs to be carried out on the reserve and at present there is only one record. This refers to the staphylinid *Lordithon trinotatus* taken on 25th October 1987 in an unidentified fungus in the pine woods.

**Carrion**

Dead seabirds and the occasional dead seal that are washed ashore, and dead rabbits found on the pastures are the primary sources of records in this category. A total of 25 species have been taken in carrion.

Three of the species recorded (*Aleochara curtula*, *Anotylus sculpturatus* and *Atheta atramentaria*) have no close connection with carrion and require no further comment. Six of the species that are not exclusive to carrion may also be found in dung and, in some cases, also in rotting vegetation, and these are *Baeckmanniolus dimidiatus*, *Philonthus sanguinolentus*, *P.splendens*, *Saprinus aeneils*, *S. cuspdatus* and *S. semi-striatus*. The last 2 species are, however, of rare occurrence in dung, and none of the 6 species have been found in that medium on the NNR. Three of the Silphids, and *T .sinuatus* are primarily carrion species but are occasionally found elsewhere. Among the Histeridae, *Hister striola* may also be found in rotting vegetation and *Paralister neglectus* also occurs, in flood refuse and

in moss. The single species of Leiodidae, *Catops grandicollis* also occurs at sap and in grass tufts. Finally, *Necrobia rufipes* occurs in old bones and skins as well as in carrion. In summary, the specialised carrion beetle fauna of the NNR comprises 7 species effectively confined thereto and a further 9 species virtually confined to carrion, but which may occasionally be found elsewhere.

It is worth noting that 2 other carrion species, *Hypocaccus metallicus* and *Phaleria cadaverina*, have been taken on the shore and on dunes in the reserve but have not yet been found in carrion.

**Dung**

The dung of various herbivorous land mammals such as cows, horses and sheep provide a nutritional base which is exploited by beetles and flies and they play an important role in the nutritional cycle of pastures, particularly in assisting with the conversion of cattle dung into humus. On the NNR the most abundant dung is that of cows and sheep, with horse dung being relatively scarce. The insect communities of cow dung in Britain are discussed in detail by Skidmore (1991).

A total of 18 species have been recorded from dung on the reserve. Three species, *Cercyon marinus, Cyphon coarctatus* and *Platystethus nitens*, have no particular connection with dung and need not be considered further. Two species, *Aphodius foetidus* and *A.ictericus*, are primarily coastal insects. Three species, *Aleochara bipustulata, A.tristis* and *Aphodius foetidus*, were all taken from dog dung. According to Skidmore *op cit A.bipustulata* is usually found in cow, sheep or horse dung; *A.tristis* in horse dung and *Aphodius foetidus* in cow or horse dung.At the time of writing no beetles have been found in horse dung on the reserve and the origin of the remaining 12 species is as follows:

| Cow dung | Sheep dung |
|---|---|
| *Aphodius fimetarius* | *Aphodius erraticus* |
| *Aphodius fossor* | *Aphodius ictericus* |
| *Aphodius rufipes* | *Cercyon quisquilius* |
| *Cercyon atomarius* | |
| *Cryptopleurum minutum* | |
| *Hister unicolor* | |
| *Oxytelus laqueatus* | |
| *Paralister carbonarius* | |
| *Sphaeridium lunatum* | |

Four of the above species, *Aphodius fimetarius, A.ictericus, A.rufipes* and *Oxytelus laqueatus*, are known to occur in dung of all types. The data tabulated above are in agreement with the list given by Skidmore *op cit* with just two exceptions - *Cercyon quisquilius* is usually found in cow and horse dung, and *Cryptopleurum minutum* in deer or horse dung-

There are 5 other species which also occur in dung and which have been recorded on the reserve, but not in that medium, and these are *Aleochara lanuginosa, Aphodius contaminatus, Baeckmanniolus dimidiatus, Hypocaccus metallicus* and *Philonthus laminatus.*

## Discussion

The research at Holkham has produced a number of records of species of particular interest in addition to scarce and threatened species.

There appear to be six new records for Norfolk and these are, in alphabetical order, *Aphthona atrovirens*, East Hills on 26.4.1994 (BS); *Brachygluta simplex*, Warham saltmarsh on 26. 4; 17.6 and 10 8.1994 (BS); *Dorytomus filirostre*, Holkham on 7.10.1988 (TJ); *Enochrus halophilus*, in brackish dyke at Holkham on 13.8.1993 and 12.4.1994 (BS); *Heterocerus obsoletus*, East Hills on 17.8.1986 (BS); and *Otiorhynchus clavipes*, at edge of Warham saltmarsh on 20.7.1986 (BS).

A further six species represent the first modern records for Norfolk- *Antherophagus pallens*, Holkham Meals on 10.7.1993 (PH); *Bembidion saxatile*, Burnham Norton on 16.4.1993 (BS); *Paralister neglectus*, in dead Guillemot on Wells saltmarsh on 16.5.1991 (BS); *Platydracus pubescens*, Holkham on 18.5.1993 (BS): *Staphylinus nero*, Burnham Overy dunes on 2.10.1994 (BS) to be confirmed; and *Stethorus punctillum*, East Hills on 10.8.1992 (PH), last recorded in Norfolk in 1904.

There are five species where the records represent range extensions in Norfolk - *Cryptophagus pseudodentatus*, at Holkham in grass litter on 17.1.1994 (BS), confirmed by Dr Colin Johnson and previously known only from Lopham Fen; *Dromius angustatus*, at Holkham on 3.8. 1956 (HH) and 12.9.1987 (PK), previously recorded only on the Stanford Battle area; *Dytiscus circumcinctus*, in dyke at Holkham on 10.10.1988 (ACW), all other records are from The Broads; *Limnoxenus niger*, in pool in pasture at Holkham on 13.8.1993 (BS), only the third record for Norfolk and the first for Vice County 28; and *Saperda carcharias*, at Holkham on 24.8.1984 (BS), the most recent Norfolk record and previously known only from The Broads area.

It is tempting to compare the beetle fauna of Holkham NNR with that of Scolt Head NNR (Welch 1982 & 1986). However, given the greater diversity of habitats at Holkham, such an exercise has its limitations. It is perhaps a reflection of habitat diversity that the number of families represented at Scolt Head is 37, and at Holkham 47. It is of interest to note that of the 380 species recorded at Scolt Head, 54 belong to the Carabidae and 135 to the Staphylinidae, while the, comparable figures for Holkham are 77 and 115 respectively.

There is little doubt that continuing research will add more species to the Holkham list. There are clearly gaps in several groups, as for example with bark beetles associated with pine trees and in the smaller species of the Staphylinidae. In the

genus *Atheta*, to take one example, 25 species have been recorded at Scolt Head but only 10 at Holkham

Despite the great extent of saltmarsh at Holkham there are a number of species associated with this habitat-type which have not yet been recorded on the NNR. Two species, *Meligethes nigrescens* Stephens and *Nephus redtenbacheri* (Mulsant), which are associated with the sea lavenders have both been recorded at Scolt Head. One further species associated with this plant is *Crepidodera impressa* (Fabricius) which has not yet been found at either locality. The same comment applies to three species of weevil, and these are *Baris scolopacea* Germar which is primarily associated with sea purslane, but on the present evidence appears to be a south and south-east coastal species; *Polydrosus pulchellus* Stephens which is associated with several saltmarsh plants and is local but widespread in its distribution; and *Trichosirocalus thalhammeri* (Schultze) which is widespread and is associated with sea plantain. Similarly, the chrysomelid *Longitarsus absynthii* Kutschera is found on sea wormwood and is known from south and south-east England; the carabid *Anisodactylus poeciloides* (Stephens) is probably phytophagous and has most recently been recorded in three Vice Counties in south-east England; finally, the staphylinid *Carpelimus halophilus* (Kiesenwetter) is widespread but very local. mention may also be made of three species in the family Anthicidae, one of which, *Anthicus instabilis* Schmidt, is a saltmarsh species that has been found at Scolt Head. Another saltmarsh species is *A.salinus* Crotch which seems to be mainly a southern England species. Lastly, *A.angustatus* Curtis is a species of sandy shores and occasionally saltmarshes, and is widespread but very local. Neither of these two species have been found at Scolt Head.

The carabid *Cicindela maritima* which has not been found at Holkham since 1952 may yet be rediscovered, since it was recorded at Thornham Point in 1995 (Key 1996).

**Acknowledgements**

I am indebted to English Nature for encouraging me to carry out research at Holkham and to their site managers, first David Henshilwood and currently Ron Harold, for assistance in various ways. The Joint Nature Conservation Committee kindly provided a list of beetle records for Holkham from the Invertebrate Site Register. I am also very grateful to the following for providing me with records - Anthony A.Allen, A.J.W.Allen, Martin Collier, Tony Drane, R.J.Driscoll, Dr Garth Foster, Adrian Fowles Paul Harding, Tom Harrison, Harry Henson, Peter Hodge, Trevor James, Dr Peter Kirby, Professor John Owen, Eric Philp and Dr A.C. Warne. For assistance in the identification of specimens I have to thank Keith Alexander, Martin Collier, Michael Cox, Trevor James, Dr Colin Johnson, Dr Martin Luff, Professor M.G.Morris, Professor John Owen and A.H.Kirk-Spriggs. Dr Roger Key kindly provided the results of an ENTSCAPE search for literature references to Coleoptera on saltmarshes and in the Burnham, Holkham and Wells-next-the-Sea area. Last, but not least, I am grateful to Martin Collier for reading and commenting on the typescript of this paper.

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## Appendix 1.

BEETLES RECORDED AT HOLKHAM NATIONAL NATURE RESERVE
Notes refer to status of beetles in Red Data Book and to habitat associations

**Anobiidae**
*Anobium punctatum* (Degeer)

**Anthicidae**
*Anthicus constrictus* Curtis — salt marsh specialist
*A formicarius* (Goeze)

**Apionidae**
*Apion (Ceratapion) carduorum* Kirby
*A. (Eutrichapion) ervi* Kirby
*A. (s.str.) frumentarium (L.)*
*A. (Protapion) fulvipes* (Geoffroy) (formerly *A.dichroum* Bedel)
*A. (Ceratapion) gibbirostre* (Gyllenhal)
*A . (s . str.) haematodes* Kirby
*A. (Pseudaplemonus) limonii* (Kirby) — Nat. Not. B. — salt marsh specialist
*A. (Ischnopapion) loti* (Kirby)
*A. (Malvapion) malvae* Fabricius
*A. (Aspidapion) radiolus* (Marsham)
*A. (Pseudapion) rufirostre* (Fabricius)
*A. (Exapion) ulicis* (Forster)
*Nanophyes marmoratus* (Goeze)

**Attelabidae**
*Deporaus betulae* (L.)
*Rhynchites aeneovirens* (Marsham)
*R. aequatus* (L.)

**Bruchidae**
*Bruchidius villosus* (Fabricius)
*Bruchus rufimanus* Boheman

**Cantharidae**
*Cantharis cryptica* Ashe
*C. figurata* Mannheim
*C. nigra* Degeer

| | | |
|---|---|---|
| *C. nigricans* (Muller) | | |
| *C. rufa* L. | | salt marsh detritus |
| *C. rustica* Fallen | | |
| *Malthodes fuscus* (Waltl) | | |
| *Rhagonycha femoralis* (Brulle) | | |
| *R. fulva* (Scopoli) | | |
| *R. lignosa* (Muller) | | |
| **Carabidae** | | |
| *Agonum dorsale* (Pontoppidan) | | |
| *A. marginatum* (L.) | | |
| *A. muelleri* (Herbst) | | |
| *Amara aenea* (Degeer) | | salt marsh detritus |
| *A. apricaria* (Paykull) | | |
| *A. convexiuscula* (Marsham) | | sand dunes |
| *A. familiaris* (Duftschmid) | | |
| *A. lucida* (Duftschmid) | Nat.Not.B | sand dunes |
| *A. ovata* (Fabricius) | | |
| *A. tibialis* (Paykull) | | |
| *Asaphidion stierlini* (Heyden) | | |
| *Bembidion aeneum* Germar | | shore species |
| *B. articulatum* (Panzer) | | |
| *B. assimile* Gyllenhal | | |
| *B. bruxellense* Wesmael | | |
| *B. ephippium* (Marsham) | Nat. Not. A | salt marsh specialist |
| *B. femoratum* Sturm | | |
| *B. genei* Kuster | | salt marsh detritus |
| *B. guttula* (Fabricius) | | |
| *B. iricolor* Bedel | | |
| *B. lampros* (Herbst) | | |
| *B. laterale* (Samouelle) | Nat.Not.B. | salt marsh specialist |
| *B. lunulatum* (Fourcroy) | | |
| *B. minimum* (Fabricius) | | salt marsh specialist |
| *B. normannum* Dejean | | salt marsh specialist |
| *B. obtusum* Serville | | |
| *B. pallidipenne* (Illiger) | Nat.Not.B. | |
| *B .quadrimaculatum* (L.) | | |
| *B .saxatile* Gyllenhal | Nat.Not.B. | |
| *B. varium* (Olivier) | | salt marsh specialist |
| *Broscus cephalotes* (L.) | | salt marsh detritus/sand dunes/shore species |
| *Calathus erratus* (Sahlberg) | | |
| *C. fuscipes* (Goeze) | | |
| *C. melanocephalus* (L.) | | |
| *C .mollis* (Marsham) | | |
| *C. piceus* (Marsham) | | |
| *Cicindela maritima* Latreille & Dejean | Nat.Not.B | sand dunes |
| *Demetrias atricapillus* (L.) | | |
| *D. monostigma* Samouelle | Nat.Not.B. | sand dunes |
| *Dicheirotrichus gustavi* Crotch | | salt marsh specialist |

| | | |
|---|---|---|
| *D. obsoletus* (Dejean) | Nat.Not.B | salt marsh specialist |
| *Dromius angustus* Brulle | | |
| *D. linearis* (Olivier) | | salt marsh detritus |
| *D. melanocephalus* Dejean | | salt marsh detritus |
| *Dyschirius aeneus* (Dejean) | | |
| *D. globosus* (Herbst) | | |
| *D. impunctipennis* Dawson | Nat.Not.B | shore species |
| *D. luedersi* Wagner | | |
| *D. politus* (Dejean) | | |
| *D. salinus* Schaum | | salt marsh specialist |
| *D. thoracicus* (Rossi) | | |
| *Elaphrus riparius* (L.) | | |
| *Harpalus affinis* (Schrank) | | |
| *H. anxius* (Duftschmid) | | |
| *H. rub ipes* (Duftschmid) | | |
| *H .rufipes* (Degeer) | | |
| *H. servus* (Duftschmid) | Nat.Not.B. | sand dunes |
| *H. tardus* (Panzer) | | |
| *H. vernalis* (Duftschmid) | Nat.Not.A. | |
| *Leistus ferrugineus* (L.) | | |
| *L. rufomarginatus* (Duftschmid) | | |
| *L. spinibarbis* (Fabricius) | | |
| *Loricera pilicornis* (Fabricius) | | |
| *Masoreus wetterhalli* (Gyllenhal) | Nat.Not.A. | |
| *Metabletus.foveatus* (Fourcroy) | | |
| *Nebria brevicollis* (Fabricius) | | |
| *N. salina* Fairmaire | | |
| *Notiophilus aquaticus* (L.) | | |
| *N. biguttatus* (Fabricius) | | |
| *Panagaeus bipustulatus* (Fabricius) | Nat.Not.B | |
| *Pogonus chalceus* (Marsham) | | salt masrh specialist |
| *P. littoralis* (Duftschmid) | Nat.Not.B. | salt marsh specialist |
| *Pterostichus nigrita* (Paykull) | | |
| *P.strenuus* (Panzer) | | |
| *Tachys scutellaris* Stephens | Nat.Not.A. | |
| *Trechus fulvus* Dejean | | shore species |
| *Trechus obtusus* Erichson | | |
| *T.quadristriatus* (Schrank) | | |
| **Cerambycidae** | | |
| *Agapannthia villosoviridescens* (Degeer) | | |
| *Arhopalus rusticus* (L.) | | pines/ Scots pines |
| *Grammoptera ruficornis* (Fabricius) | | |
| *Leptura rubra* L. | | |
| *Saperda carcharias* (L.) | Nat.Not.A. | |
| **Chrysomelidae** | | |
| *Altica lythri* Aube | | |
| *Aphthona atrocaerulea* (Stephens) | | |
| *A.atrovirens* Foerster | | |

| | | |
|---|---|---|
| *A. euphorbiae* (Schrank) | | |
| *A. melancholica* Weise | | |
| *Cassida rubiginosa* Muller | | |
| *C.vittata* de Villers | | |
| *Chaetocnema hortensis* (Fourcroy) | | |
| *Chalcoides aurata* (Marsham) | | |
| *C. aurea* (Fourcroy) | | |
| *C. fulvicornis* (Fabricius) | | salt marsh detritus |
| *Chrysolina staphylea (L.)* | | |
| *Crepidodera ferruginea* (Scopoli) | | |
| *Cryptocephalus fulvus* Goeze | | |
| *Donacia simplex* Fabri.ius | | |
| *Galerucella lineola* (Fabricius) | | |
| *G. pusilla (*Duftschmid) | | |
| *G sagittariae* (Gyllenhal) | | |
| *Hippuriphila modeeri* (I..) | | |
| *Lochmaea crataegi* (Forster) | | |
| *Longitarsus jacobaeae* (Waterhouse) | | |
| *L.parvulus* (Paykull) | | |
| *L. plantagomaritimus* Dollmar | Nat.Not.B. | salt marsh specialist |
| *Luperus longicornis* (Fabricius) | | |
| *Oulema melanopa* (L.) | | |
| *Phaedon armoraciae* (L.) | | |
| *Phaedon cochleariae* (Fabricius) | | |
| *P.concinnus* Stephens | Nat.Not.B. | salt marsh detritus |
| *P.tumidulus* (Germar) | | |
| *Prasocuris junci* (Brahm) | | |
| *Psylliodes marcida* (Illiger) | | sand dunes |
| *Sermylassa halensis* (L.) | | |
| **Cleridae** | | |
| *Necrobia rufipes* (Degeer) | | carrion (not confined to) |
| *Thanasimus formicarius* (L.) | | pines |
| **Coccinellidae** | | |
| *Adalia bipunctata* (L.) | | |
| *Anatis ocellata* (L.) | | pines/Scots pines |
| *Calvia 14-guttata* (L.) | | |
| *Coccidula rufa* (Herbst) | | |
| *Coccinella 7-punctata* L. | | salt marsh detritus |
| *C. ll-punctata* (L.) | | |
| *Harmonia quadripunctata* (Pontoppidan) | | pines/Scots pines |
| *Myrrha 18-guttata* (L.) | | |
| *Propylea 14-punctata* (L.) | | |
| *Rhyzobius litura* (Fabricius) | | |
| *Stethorus punctillum* (Weise) | | |
| *Subcoccinella 24-punctata* (L.) | | |
| *Thea 22-Punctata* (L.) | | |
| *Tytthaspis 16-punctata* (L.) | | |

**Colydiidae**
*Orthocerus clavicornis* (L.) Nat.Not.B.

**Corylophidae**
*Corylophus cassidoides* (Marsham)
*C. sublaevipennis* Jacquelin du Val

**Cryptophagidae**
*Antherophagus pallens* (L.)
*Atomaria lewisi* Reitter
*A. mesomela* (Herbst)
*A. nigirostris* Stephens
*A. nitidula* (Marsham)
*Cryptophagus scanicus* (L.)
*C. pseudodentatus* Bruce
*Diphistemus globulus* (Paykull)

**Curculionidae**
*Anthonomus pedicularis* (L.)
*A. rubi* (Herbst)
*Ceutorhynchus pallidactylus* (Marsham) (formerly *C.quadridens* (Panzer))
*Coeliodes erythroleucos* (Marsham) Nat. Not.B
*Curculio pyrrhoceras* (Marsham)
*C. salicivorus* Paykull
*Datonychus melanostictus* (formerly *Ceutorhynchus melanostictus* (Marsham))
*Dorytomus dejeani* Faust
*D. filirostris* Gyllenhal Nat.Not.B.
*D. rufatus* (Bedel)
*Gronops lunatus* (Fabricius) Nat.Not.B.
*Gymnetron pascuorum* (Gyllenhal)
*Hylobius abietis* (L.) pines
*Hypera arator* (L.)
*Magdalis armigera* (Fourcroy)
*Mecinus collaris* Gemar Nat.Not.B.
*Mogulones asperifoliarum* (Gyllenhal) (formerly *Ceutorhynchus asperifolarum* (Gyll.)
*Otiorhynchus clavipes* (Bonsdorff)
*O. desertus* Rosenhauer Nat.Not.B.
*O. ovatus* (L.) sand dunes
*O. rugostriatus* (Goeze)
*O. singularis* (L.)
*O. sulcatus* (Fabricius)
*Philopedon plagiatus* (Schaller) sand dunes
*Phyllobius pyri* (L.)
*P. roboretanus* Gredler
*P. vespertinus* (Fabricius) Nat.Not.B
*P. viridiaeris* (Laicharting)
*Phytobius leucogaster* (Marsham) (formerly *Litodactylus leucogaster* (Marsham))
Nat.Not.B.

| | | |
|---|---|---|
| *Pissodes castaneus* | | pines |
| *P. pini* (L.) | | pines |
| *Polydrusus cervinus* (L.) | | |
| *P. confluens* Stephens | Nat.Not.B | |
| *P. pulchellus* Stephens | | |
| *Pselactus spadix* (Herbst) | Nat.Not.B. | shore species |
| *Sitona hispidulus* (Fabricius) | | |
| *S. humeralis* Stephens | | |
| *S. lepidus* Gyllenhal | | |
| *S. lineatus* (L.) | | |
| **Dermestidae** | | |
| *Dermestes murinus* L. | | carrion |
| **Derodontidae** | | |
| *Laricobius erichsoni* Rosenhauer | | |
| **Dytiscidae** | | |
| *Agabus bipustulatus* (L.) | | freshwater |
| *A.conspersus* (Marsham) | Nat.Not.B. | brackishwater |
| *A.nebulosus* (Forster) | | freshwater |
| *A.sturmi* (Gyllenhal) | | freshwater |
| *Coelambus impressopunctctus* (Schaller) | | freshwater |
| *C. parallelogrammus* (Ahrens) | | brackishwater |
| *Colymbetes fuscus* (L.) | | freshwater |
| *Copelatus haemorrhoidalis* (Fabricius) | | freshwater |
| *Dytiscus circumcinctus* Ahrens | Nat.Not.A. | freshwater |
| *D. marginalis* L. | | freshwater |
| *Graptodytes pictus* (Fabricius) | | freshwater |
| *Hydroporus memnonius* Nicolai | | freshwater |
| *H. palustris* (L.) | | freshwater |
| *H. planus* (Fabricius) | | freshwater |
| *H. striola* (Gyllenhal) | | freshwater |
| *H. tessellatus* Drap. | | freshwater |
| *H.tristis* (Paykull) | | freshwater |
| *Hygrotus inaequalis* (Fabricius) | | freshwater |
| *H.versicolor* (Schaller) | | freshwater |
| *Hyphydrus ovatus* (L.) | | freshwater |
| *Ilybius ater* (Degeer) | | freshwater |
| *I. fenestratus* (Fabricius) | Nat.Not.B | freshwater |
| *I. fuliginosus* (Fabricius) | | freshwater |
| *I. quadriguttatus* (Lacordaire & Boisduval) | | freshwater |
| *Laccophilus hyalinus* (Degeer) | | freshwater |
| *L. minutus* (L.) | | freshwater |
| *Potamonectes depressus ssp.elegans* (Panzer) | | freshwater |
| *Stictotarsus duodecimpustulatus* (Fabricius) | | freshwater |
| *Suphrodytes dorsalis* (Fabricius) | | freshwater |
| **Elateridae** | | |
| *Agriotes lineatus* (L.) | | |

| | | |
|---|---|---|
| *A. obscurus* (L.) | | |
| *A. pallidulus* (Illiger) | | |
| *A. sputator* (L.) | | |
| *Agrypnus murinus* (L.) | | |
| *Athous haemorrhoidalis* (Fabricius) | | |
| *Cidnopus aeruginosus* (Olivier) | | |
| *Dolopius marginatus* (L.) | | |
| *Prosternon tessellatum* (L.) | | |
| **Elmidae** | | |
| *Elmis aenea* (Muller) | | freshwater |
| **Gyrinidae** | | |
| *Gyrinus caspius* Menetries | | freshwater |
| *G. marinus* Gyllenhal | | fresh, peaty and brackish waters |
| *G.substriatus* Stephens | | brackishwater |
| **Haliplidae** | | |
| *Haliplus apicalis* Thomson | Nat.Not.B. | brackishwater |
| *H. confinis* Stephens | | freshwater |
| *H. flavicollis* Sturm | | freshwater |
| *H. immaculatus* Gerhardt | | freshwater |
| *H. lineaticollis* (Marsham) | | freshwater |
| *H. lineolatus* Mannerheim | | freshwater |
| *H. ruficollis* (Degeer) | | freshwater |
| *H. wehnckei* Gerhardt | | freshwater |
| **Heteroceridae** | | |
| *Heterocerus fenestratus* (Thunberg) | | |
| *H. flexuosus* Stephens | | salt marsh specialist |
| *H . fossor* Kiesenwatter | | salt marsh specialist |
| *H. maritimus* Guerin-Meneville | | salt marsh specialist |
| *H. obsoletus* Curtis | | salt marsh specialist |
| **Histeridae** | | |
| *Baeckmanniolus dimidiatus* (Illiger) | Nat.Not.B. | carrion (not confined to) |
| *Hister striola* Sahlberg | | carrion (not confined to) |
| *H. unicolor* L. | | |
| *Hypocaccus metallicus* (Herbst) | Red Data Bk.3. | sand dunes |
| *Onthophilus striatus* (Forster) | | |
| *Paralister carbonarius* (Hoffman) | | carrion (not confined to) |
| *P. neglectus* (Germar) | | |
| *Saprinus aeneus* (Fabricius) | | carrion (not confined to) |
| *S. cuspidatus* Ihssen | Nat.Not.B. | carrion (not confined to) |
| *S. semistriatus* (Scriba) | | carrion (not confined to) |
| **Hydraenidae** | | |
| *Limnebius truncatellus* (Thunberg ) | | freshwater |
| *Ochthebius auriculatus* Rey | Nat.Not.B. | brackish water |

| | | |
|---|---|---|
| *O. dilatatus* Stephens | | freshwater |
| *O . marinus* (Paykull ) | Nat.Not.B. | salt marsh detritus/brackish |
| *O . minimus* (Fabricius) | | freshwater |
| *O. nanus* Stephens | Nat.Not.B. | |
| **Hydrophilidae** | | |
| *A.bipustulata* (Marsham) | | |
| *Anacaena globulus* (Paykull) | | freshwater |
| *A. limbata* (Fabricius ) | | freshwater |
| *A. lutescens* (Stephens ) | | freshwater |
| *Cercyon atomarius* (Fabricius) | | |
| *C . haemorrhoidalis* (Fabricius ) | | |
| *C. littoralis* (Gyllenhal) | | salt marsh detritus/shore |
| *C . marinus* Thomson | | freshwater |
| *C. melanocephalus* (L.) | | salt marsh detritus |
| *C. quisquilius* (L. ) | | |
| *Coelostoma orbiculare* (Fabricius) | | freshwater |
| *Cryptopleurum minutum* (Fabricius) | | |
| *Cymbiodyta marginella* (Fabricius) | | freshwater |
| *Enochrus bicolor* (Fabricius) | Nat.Not.B. | brackish water |
| *E. coarctatus* (Gredler) | | freshwater |
| *E. halophilus* (Bedel) | Nat.Not.B. | brackish water |
| *E. melanocephalus* (Oliver) | Nat.Not.B. | |
| *E. quadripunctatus* (Herbst) | Nat.Not.B. | freshwater |
| *E. testaceus* (Fabricius) | | freshwater |
| *Helophorus aequalis* Thomson | | freshwater |
| *H. brevipalpis* Bedel | | freshwater |
| *H. fulgidicollis* Motschulsky | Nat.Not.B. | salt marsh /freshwater |
| *H. grandis* Illiger | | salt marsh detritus/freshwater |
| *H. granularis* (L.) | | freshwater |
| *H. griseus* Herbst | Nat.Not.B. | |
| *H. minutus* Fabricius | | freshwater |
| *H. strigifrons* Thomson | Nat.Not.B. | freshwater |
| *Hydrobius fuscipes* (L.) | | freshwater |
| *Laccobius biguttatus* Gerhardt | | freshwater |
| *L. bipunctatus* (Fabricius) | | freshwater |
| *L. minutus* (L.) | | freshwater |
| *L. striatulus* (Fabricius) | | freshwater |
| *Limnoxenus niger* (Zschach) | | freshwater |
| *Sphaeridium lunatum* Fabricius | | |
| *S. scarabaeoides* (L.) | | |
| **Hygrobiidae** | | |
| *Hygrobia hermanni* (Fabricius) | | freshwater |
| ***Lathridiidae*** | | |
| *Aridius nodifer* (Westwood) | | |
| *Corticaria crenulata* (Gyllenhal) | | salt marsh detritus |
| *C. impressa* (Olivier) | | salt marsh detritus |
| *C. punctulata* Marsham | | |

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|---|---|---|
| *orticarina fuscula* (Gyllenhal) | | |
| *ortinicara gibbosa* (Herbst) | | sand dunes |
| *nicmus transversus* (Olivier) | | |
| *ephostethus lardarius* (Degeer) | | |
| **eelodidae** | | |
| *atops chrysomeloides* (Panzer) | | |
| *grandicollis* Erichson | | carrion (not confined to) |
| *ydnobius punctatus* (Sturm) | Nat.Not.Sc. | |
| *eiodes dubia* (Kugelann) | | |
| *obesa* (Schmidt) | | |
| *richohydnobius suturalis* (Zetterstedt) | Red Data Bk. K. | sand dunes |
| *tomaphagus subvillosus* (Goeze) | | |
| **Helyridae** | | |
| *nthocomus rufus* (Herbst) | | |
| *olichosoma lineare* (Rossi) | Nat.Not.B. | |
| *Malachius barnevillei* Puton | Red Data Bk.3. | sand dunes |
| **Mordellidae** | | |
| *Mordellistena pumila* (Gyllenhal) | | |
| **Nitidulidae** | | |
| *Carpophilus marginellus* Motschulsky | | |
| *Nychramus luteus* (Fabricius) | | |
| *Silischrochilus hortensis* (Fourcroy) | | salt marsh detritus |
| *Meligethes aeneus* (Fabricius) | | salt marsh detritus |
| *M. erythropus* (Marsham) | | |
| *M. flavimanus* Stephens | | |
| *M. fulvipes* Brisout | | |
| *M. obscurus* Erichson | | |
| *M. viridescens* (Fabricius) | | |
| *Omosita colon* (L.) | | carrion |
| *Pria dulcamarae* (Scopoli) | | |
| **Noteridae** | | |
| *Noterus clavicornis* (Degeer) | | freshwater |
| **Oedemeridae** | | |
| *Nacerdes melanura* (L.) | | |
| *Oedemera nobilis* (Scopoli) | | |
| *Oncomera femorata* (Fabricius) | Nat.Not.B. | |
| **Phalacridae** | | |
| *Olibrus corticalis* (Panzer) | | |
| *Stilbus testaceus* (Panzer) | | |
| **Pselaphidae** | | |
| *Brachygluta helferi* (Schmidt-Goebl) | | salt marsh specialist |
| *B. simplex* (Waterhouse) | Nat.Not.Sc. | salt marsh specialist |

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|---|---|---|
| *Tychus niger* (Paykull) | | salt marsh detritus |
| **Ptilidae** | | |
| *Acrotrichis fascicularis* (Herbst) | | |
| *Ptenidium punctatum* (Gyllenhal) | | |
| **Pyrochroidae** | | |
| *P*yrochroa serràticornis (Scopoli) | | |
| **Rhizophagidae** | | |
| *Rhizophagus dispar* (Paykull) | | |
| **Salpingidae** | | |
| *Salpingus reyi* (Abeille) | | |
| **Scarabaeidae** | | |
| *Aegialia arenaria* (Fabricius) | | sand dunes/shore species |
| *Amphimallon solstitalis* (L.) | | |
| *Anomala dubia* (Scopoli) | | sand dunes |
| *Aphodius ater* (Degeer) | | |
| *A. contaminatus* (Herbst) | | |
| *A distinctus* (Muller) | Nat.Not.B. | |
| *A. erraticus* (L) | | |
| *A. fimetarius* (L.) | | |
| *A. foetidus* Herbst. | | |
| *A. fossor* (L.) | | |
| *A .ictericus* (Laicharting) | | |
| *A. merdarius* (Fabricius) | | |
| *A. prodromus* (Brahm) | | |
| *A. rufipes* (L.) | | |
| **Scirtidae** | | |
| *Cyphon coarctatus* Paykull | | |
| *C. variabilis* (Thunberg) | | |
| **Scolytidae** | | |
| *Hylastes ater* (Fabricius) | | pines/Scots pines |
| **Scraptiidae** | | |
| *Anaspis maculata* Fourcroy | | |
| *A. regimbata* Schilsky | | |
| **Silphidae** | | |
| *Necrodes littoralis* (L.) | | carrion |
| *Nicrophorus humator* (Gleditsch) | | carrion |
| *N. vespillo* (L.) | | carrion |
| *N. vespilloides* Herbst. | | carrion |
| *Oiceoptoma thoracicum* (L.) | | carrion (not confined to) |
| *Thanatophilus rugosus* (L.) | | carrion (not confined to) |
| *T. sinuatus* (Fabricius) | | carrion (not confined to) |

| | | |
|---|---|---|
| **taphylinidae** | | |
| *leochara curtula* (Goeze) | | |
| .. *grisea* Kraatz. | | |
| .. *lanuginosa* Gravenhorst | | |
| .. *obscurella* Gravenhorst | | |
| .. *tristis* Gravenhorst | | |
| *loconota gregaria* (Erichson) | | |
| *mischa decipiens* (Sharp) | | salt marsh detritus |
| *notylus inustus* Gravenhorst | | |
| .. *maritimus* Thomson | | shore species |
| .. *rugosus* (Fabricius) | | |
| .. *sculpturatus* (Gravenhorst) | | |
| .. *tetracarinotus* (Block) | | salt marsh detritus |
| *theta aterrima* (Gravenhorst) | | salt marsh detritus |
| .. *atramentaria* (Gyllenhal) | | |
| .. *fungi* (Gravenhorst) | | salt marsh detritus |
| .. *graminicola* (Gravenhorst) | | salt marsh specialist |
| .. *malleus* Joy | | salt marsh detritus |
| .. *orbata* (Erichson) | | salt marsh detritus |
| .. *triangulum* (Kraatz) | | salt marsh detritus |
| .. *vestita* (Gravenhorst) | | salt marsh detritus |
| .. *volans* (Scriba) | | salt marsh detritus |
| .. *xanthopus* (Thomson) | | |
| *Atrecus affinis* (Paykull) | | |
| *Autalia longicornis* Scheerpeltz | | |
| *Bledius atricapillus* (Germar) | | |
| *B. bicornis* (Germar) | Nat.Not.A. | salt marsh specialist |
| *B. diota* Schodte | Red Data Bk K | salt marsh specialist |
| *B. fergussoni* Joy | | shore species |
| *B. furcatus* (Olivier) | Red Data Bk.I | salt marsh specialist |
| *B. fuscipes* Rye | | salt marsh specialist |
| *B. germanicus* Wagner | | salt marsh specialist |
| *B. spectabilis* Kraatz | | salt marsh specialist/shore |
| *B. subniger* Schneider | | salt marsh specialist |
| *B. subterraneus* Erichson | | |
| *B. tricornis* (Herbst) | Nat.Not.B. | salt marsh specialist |
| *B. unicornis* (Germar) | | salt marsh specialist |
| *Bolitobius analis* (Fabricius) | | |
| *Cafius xantholoma* (Gravenhorst) | | sand dunes/ shore species |
| *Chiloporata longitarsis* (Erichson) | | salt marsh detritus |
| *Coprophilus striatulus* (Fabricius) | | |
| *Creophilus maxillosus* (T.) | | carrion |
| *Cypha longicornis* (Paykull) | | |
| *Diglotta mersa* (Halliday) | | |
| *D. submarina* (Fairmaire & Laboulbene) | Nat.Not.Sc. | |
| *Dinaraea angustula* (Gyllenhal) | | |
| *Euspthalerum minutum* (Fabricius) | | |
| *Gyrohypnus angustata* Stephens | | |
| *G. fracticornis* (Muller) | | salt marsh detritus |
| *G. punctulatus* (Paykull) | | salt marsh detritus |

| | | |
|---|---|---|
| *Halobrecta algae* (Hardy) | | salt marsh detritus |
| *Heterothrops binotatus* (Gravenhorst) | | salt marsh detritus/sand dunes |
| *Lathrobium fulvipenne* (Gravenhorst) | | |
| *Lordithon trinotatus* (Erichson) | | |
| *Metopsia retusa* (Stephens) | | |
| *Oligota pumilio* Kiesenwetter | | salt marsh detritus |
| *Omalium laeviusculum* Gyllenhal | | |
| *O. riparium* Thomson | | salt marsh detritus |
| *Ontholestes murinus* (L.) | | |
| *Oxytelus laqueatus* (Marsham) | | |
| *Oxypoda elongatula* Aube | | |
| *O. opaca* (Gravenhorst) | | salt marsh detritus |
| *O. umbrata* (Gyllenhal) | | salt marsh detritus |
| *Philonthus cognatus* Stephens | | salt marsh detritus |
| *P. concinnus* (Gravenhorst) | | |
| *P. cruentatus* (Gmelin) | | |
| *P. fimetarius* (Gravenhorst) | | |
| *P. laminatus* (Creutzer) | | |
| *P. marginatus* (Strom) | | salt marsh detritus |
| *P. politus* (L.) | | |
| *P. quisquilarius* (Gyllenhal) | | |
| *P. rectangulus* Sharp | | |
| *P. sanguinolentus* (Gravenhorst) | | carrion (not confined to) |
| *P. splendens* (Fabricius) | | carrion (not confined to) |
| *P. tenuicornis* Mulsant & Rey | | carrion (not confined to) |
| *P. varians* (Paykull) | | salt marsh detritus |
| *P. varius* (Gyllenhal) | | |
| *P. ventralis* (Gravenhorst) | | |
| *Phytosus balticus* Kraatz | | shore species |
| *Platydracus pubescens* (Degeer) | Nat.Not.B. | |
| *Platystethus cornutus* (Gravenhorst) | | |
| *P. nitens* (Sahlberg) | | |
| *P. nodifrons* Mannerheim | Nat.Not.Sc. | |
| *Polystoma punctatella* Motschulsky | (formerly *Aleochara bipustulata* (L)) | |
| *Proteinus ovalis* Stephens | | salt marsh detritus |
| *Quedius fuliginosus* (Gravenhorst) | | |
| *Q. lateralis* (Gravenhorst) | | |
| *Q. mesomelinus* (Marsham) | | |
| *Q. picipes* (Mannerheim) | | |
| *Q. semiobscurus* (Marsham) | | |
| *Q. simplicifrons* Fairmaire | | salt marsh specialist |
| *Rugilus erichsoni* (Fauvel) | | |
| *R.orbiculatus* (Paykull) | | salt marsh detritus |
| *Sepedophilus lusitanicus* Hammond | | |
| *S. marshami* (Stephens) | | |
| *S. nigripennis* (Stephens) | | |
| *Staphylinus aeneocephalus* Degeer | | |
| *S. ater* Gravenhorst | | salt marsh specialist |
| *S. compressus* Marsham | | |
| *S. erythropterus* (L.) | | |

| | | |
|---|---|---|
| *S. compressus* Marsham | | |
| *S. erythropterus* (L.) | | |
| *S. melanarius* Heer | | |
| *S. nero* Faldermann | | |
| *S. olens* Muller | | salt marsh detritus |
| *Stenus clavicornis* (Scopoli) | | |
| *S. rogeri* Kraatz | | |
| *S. solutus* Erichson | | |
| *S .tarsalis* Ljungh | | |
| *Tachinus signatus* Gravenhorst | | carrion (not confined to) |
| *Tachyporus chrysomelinus* (L.) | | |
| *T. hypnorum* (Fabricius) | | salt marsh detritus |
| *T. obtusus* (L.) | | |
| *T. pusillus* Gravenhorst | | |
| *T. solutus* Erichson | | |
| *Xantholinus glabratus* (Gravenhorst) | | salt marsh detritus |
| *X. linearis* (Olivier) | | |
| *X. longiventris Heer* | | |
| **Tenebrionidae** | | |
| *Crypticus quisquilius* (L.) | Nat.Not.B. | sand dunes |
| *Cteniopus sulphureus* (L.) | | |
| *Isomira murina* (L.) | | |
| *Lagria hirta* (L.) | | |
| *Melanimon tibialis* (Fabricius) | | |
| *Phaleria cadaverina* (Fabricius) | | shore species |
| *Phylan gibbus* (Fabricius) | | sand dunes |

## A NEW FUNGUS FOR NORFOLK - *BATTARAEA PHALLOIDES* (DICKS.) PERS

Mark Gurney
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This distinctive species related to the puffballs is very rare with only three modern British localities in southern and eastern England and is only predictably known from one hedge bank in Suffolk. In 1995 specimens were collected by a university student from Danby Wood near Norwich. On the 7th June 1996 I discovered a further three specimens in the locality though it is unclear whether it is exactly the same site. The habitat where I found it is a sandy south-east facing roadside bank topped by a hawthorn hedge. The specimens were growing amongst sparse grass, about half way up the bank and were small, about 6cm in height, probably reflecting the drought conditions prevailing at the time. As far as I can ascertain this is the first record for Norfolk.

# WATER QUALITY AT WHEATFEN

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## Introduction

Wheatfen Nature Reserve lies on the River Yare 14 Km below Norwich. Among its most attractive features are the reed beds, marsh dykes and some small broads. In the immediate post-war period the water quality at Wheatfen Broad underwent a grave deterioration. The water became turbid and the many aquatic macrophytes disappeared. This was accompanied by a loss of the invertebrates associated with the water plants and by the loss of fish and of the bird life which depended on the fish and invertebrates.

In the last few years there have been hopeful signs that this process is being reversed. Shoals of young fish have been seen and kingfishers have become more common on the Wheatfen waters. A survey of aquatic invertebrates has shown that their status is returning to what it was fifty years ago. Some aquatic macrophytes have begun to colonise the ditches and colonies of green filamentous algae are a feature of the mud surface in Wheatfen Broad and Deep Waters.

The trustees of the Ted Ellis Trust, which owns the 100 acres of reserve at Wheatfen wished to know how the water quality has been changing and for what reason so that their planning could take account of trends in water quality. The present paper sums up part of the research which has been undertaken.

Before the situation began to improve, Ives (1990) carried out some research at Wheatfen, in the course of which she looked at the water quality in the broads and channels.

Besides her own measurements she abstracted data from the National Rivers Authority database, the COPA II Register at Peterborough. This was for the two sampling points on the River Yare at Coldham Hall and Buckenham Ferry, above and below the Wheatfen area.

She compared her results from five stations at Wheatfen with those for the River Yare (Table 1). Results from the five stations at Wheatfen were very close to each other and the mean of the five was taken for comparison with the river.

**Table 1.**

| Determinant | Wheatfen Mean | Standard Deviation | Coldham Hall | Buckenham Ferry |
|---|---|---|---|---|
| Total Phosphorus | 1079 | 36.52 | 1300 | 1190 |
| Nitrate | 2248 | 104 | | |
| Ammonium | 116 | 6.7 | 130 | 100 |
| pH value | 7.92 | .054 | | |
| Chlorophyll a | 108.48 | 34.4 | | |

Values (except pH) are in microgrammes per litre. Values are for July for the River Yare and August for Wheatfen. Evidently the nutrient status of the Wheatfen water is close to the River Yare and for practical purposes the records for Coldham Hall could be taken as a first approximation to the behaviour of values at Wheatfen.

A.K. Darby of St Johns College Cambridge reached the same conclusion in 1982, pointing out that the retention period for water in the Rockland - Wheatfen complex was only 1.5 tides.

Ives also plotted the results from the two stations on the river Yare for a 24 month period. The natural recovery of the river quality can be seen as it passed through the zone by looking at the mean values of ammonia, 406 µg/l at Coldham Hall and 281 µg/l at Buckenham Ferry. Total oxidised nitrogen and total phosphorus do not differ much between the two sites. The time-based graphs for the two stations do not show much difference, Total nitrogen was low in summer and high in winter, Phosphorus tended to be low in spring, no doubt as a result of algal growth. This algal growth probably accounts for the higher pH values recorded at Buckenham Ferry at this time of the year in comparison with Coldham Hall.

Earlier studies of Wheatfen and the Yare illustrate the effects of the high nutrient status of the river ( Clarke 1963), (Leah *et al.* 1980). The work of Leah et al is particularly useful as they studied two newly excavated broads about midway between the Whitlingham Sewage Outfall and Wheatfen.

## Method

The outfall of Whitlingham Sewage Treatment Works is 10 Km upstream from Wheatfen. Since the new sewage works improvements were commissioned in November 1991 we have been noticing an apparent improvement in water quality at Wheatfen. It seemed that with advantage we could compare a 24 months period after the commissioning (Summer 1992 to Summer 1994) with the period studied by Ives ( Summer 1987 to Summer 1989) and see what changes have taken place in the five year interval. In order to confirm that our use of River Yare analyses was a reliable guide to Wheatfen water quality, Anglian Water kindly agreed to examine a series of samples from Wheatfen taken at the same time as the NRA sampled the river at Coldham Hall and Buckenham Ferry.

## Results

### Water Chemistry

The results obtained by Anglian Water are shown in Table 2. The mean of some of the determinands was taken and compared with the NRA results shown in the Control of Pollution Act Register. We found that, as with Ives (1990), the best comparison was with Coldham Hall as this avoided the slight estuarine influences which can be observed at Buckenham Ferry.

Turbidity at Wheatfen, taking the mean of 4 samples was 8% below Coldham Hall and Conductivity was 6% below. Chloride was 3.5% below and the Ammonia mean was the same as Coldham Hall mean of the four months sampled. Total Oxidised Nitrogen was much lower. It was 30% lower than Coldham Hall and 26% lower than Buckenham Ferry. These are for mean values. This divergence grew more marked on individual samples as the summer progressed. In May the TON result at Wheatfen was only half of that at Coldham Hall.

### Ammonia

In the two year period studied by Ives, before the Whitlingham improvements came into use, the mean value for Ammonia at Coldham Hall was 406 µg/l (n=24) quoted as ammonium. This corresponds to 315 µg/l nitrogen. The figure for the period 1992-1994 was 87 µg/l N. This reduction of almost three quarters of the ammonia has been due, without a doubt, to the efforts of Anglian Water Services. The effluent standard at Whitlingham was 40 mg/l of Nitrogen in Ammonia before the standard was reduced by NRA to 7 mg/l in 1992. The new works have been able to meet this dramatic lowering of the consent and in fact they achieve a standard of only 1 mg/l ammonia.

The mean value of ammonia nitrogen at Buckenham was almost the same as Coldham Hall in 1992-94. Ives found that the mean Ammonium value fell from 406.62 µg/l to 281.48 µg/l between Coldham Hall and Buckenham Ferry in the earlier period. The present lack of difference between Coldham Hall and Buckenham could be taken to indicate, perhaps, that the current ammonia nitrogen level is incapable of further reduction by natural means in the river. The situation is more complex in reality. In only 10 of the 24 months reviewed did the ammonia nitrogen fall downstream.

### Nitrate etc

Total oxidised nitrogen (which is predominantly nitrates) reduced only slightly as the water passed downstream in the earlier period (2.9% drop). The situation is the same today. There is in fact now a slight increase. Overall the TON value has decreased at Coldham Hall by 0.04% since before the improvements were made at Whitlingham and increased by 4 % at Buckenham Ferry. We would not have expected an improvement as Whitlingham does not include a nitrate removal phase and in any case, a high proportion of oxidised nitrogen in the lower Yare is derived from agricultural run-off. (Edwards 1971)

## Phosphorus

Ives found that phosphorus values remained unchanged as the water passed down river from Coldham Hall to Buckenham Ferry. This is still so today. Values have reduced by 8% and 12% at the two sites. This may however reflect a change in determinand (total Phosphorus against soluble reactive phosphorus) rather than an improvement in effluent quality.

**Table 2**

| | 16.2.95 | 14.3.95 | 25.5.95 | 13.4.95 |
|---|---|---|---|---|
| pH | 8.19 | 7.92 | 8.27 | 8.03 |
| Turbidity FTU | 8.4 | 4.2 | 3.5 | 1.97 |
| Colour Hazen | 16 | 15 | 16 | 14 |
| Conductivity µs/cm | 799 | 815 | 788 | 830 |
| BOD mg/l O | 2.4 | | | |
| Ammonia mg/l $NO_4$ | 0.08 | 0.05 | 0.29 | 0.1 |
| TON mg/$NO_3$ | 38.8 | 26.7 | 15.6 | |
| Nitrate mg/l $NO_3$ | 38.86 | 26.5 | 15.3 | 17.8 |
| Nitrite mg/l $NO_2$ | 0..141 | 0.095 | 0.244 | 0.133 |
| Total hardness $CaCO_3$ | 365 | 326 | 354 | |
| Alkalinity mg/l $CaCO_3$ | 270 | 264 | 264 | |
| Chlorides mg/l Cl | 51 | 57 | 63 | 70 |
| Silicate RD mg/l $SiO_4$ | 9 | 7 | 3 | |
| Sulphate mg/l $SO_4$ | 62.5 | 63.5 | | 76 |
| Sodium mg/l Na | 26 | 30 | 35 | |
| Potassium mg/l K | .2 | 4.4 | 5.2 | |
| Magnesium mg/l Mg | 4.2 | 4.6 | 5 | |
| Calcium mg/Ca | 141 | 138 | 130 | |
| Iron mg/l Fe | 0.252 | 0.257 | 0.0193 | 0.0478 |
| Manganese µg/l Mn | 24.5 | 114 | 15.3 | 18.1 |
| Phosphorus mg/l P | | | | 1.05 |

## Turbidity

While chemical changes in the river water quality following the improvements at Whitlingham would be evident relatively quickly, the desired changes in biology might be much slower. One such change is the turbidity of the water.

Turbidity at Wheatfen and in the Coldham Hall - Buckenham reaches of the river is a complex phenomenon. It is derived in part from land run-off, in part from the Whitlingham effluent, in part from phytoplankton growing in the water and in part from the sediment moving into the reaches from the lower estuary. The Whitlingham effluent consent standard has been lowered in 1992 by the NRA from 50 mg/l to 40 mg/l (Total dissolved solids). In actual fact the works achieve their own standard of 20 mg/l. The improvement in quality might also have affected the mobility of sediments within the area.

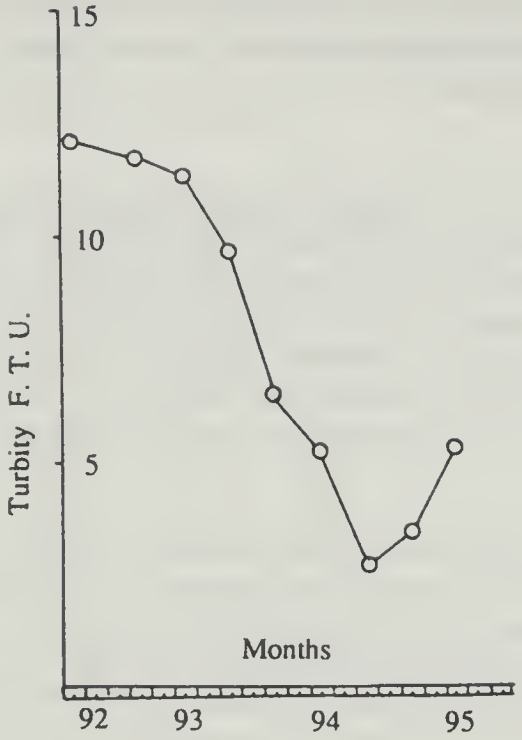


**Figure1.** Turbidity of River Yare at Coldham Hall 1992-1995. Points represent the mean of the previous four months readings. Source National Rivers Authority Register under Control of Pollution Act.

Whatever the cause there has been a dramatic improvement in the turbidity of the water at Wheatfen. This has been remarked by visitors and wardens and is borne out by the series of results in the river for the last two years. Figure 1 shows the four month average for the 1992-1995 data. At Coldham Hall there has been a steady reduction to less than half the turbidity at the beginning of the period. At Buckenham, where the influence of lower estuary imports of turbidity is more marked the results are not so consistent but even here there has been a distinct reduction. (Figure 2)

From August 1992 until January 1993 the turbidity at Buckenham Ferry was in excess of 19 FTU, the upper limit of reporting. From October 1993 to August 1995 it only exceeded 10 FTU on three occasions.

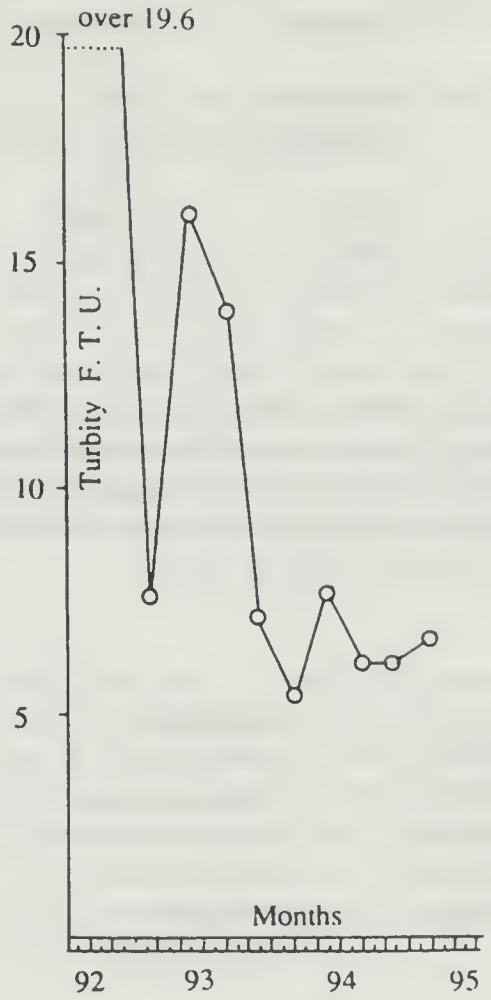


**Figure 2.** Turbidity of River Yare at Buckenham Ferry 1992-1995. Points represent the mean of the previous three months readings. Source National Rivers Authority Register under Control of Pollution Act.

## Bacteria

The bacterial quality of the water is not shown in the records we have obtained. It is however good to note that the NRA Yare Catchment management plan provides for setting target levels for the Coldham Hall - Rockland reaches ( due to the needs of water skiers) and for the achievement of these levels by Anglian Water Services.

## Algae

Counts of plankton algae were carried out for various reasons at irregular intervals over the period from the end of 1990. The bulk of algae in these peaks were centric diatoms. Evidently there has been no dramatic reduction of the numbers of plankton algae present in the Wheatfen waters. The summer peaks were usually *Skeletonema subsalsum* ( Cleve-Euler) Bethge. (Clarke, 1995)

Maximum counts of the number of algal cells per ml were

| | Spring | Summer | Autumn |
|---|---|---|---|
| 1991 | 16,900 | | < 20 |
| 1992 | 8,400 | 13,616 (see below) | 93 |
| 1993 | | | 132 |
| 1994 | | 5283 | 13,419 |
| 1995 | 350 | 2569 | 80 |
| 1996 | 5306 | | |

In 1994 mud was pumped from the two larger broads by the Broads Authority (Clarke & Baker, 1995) and in 1995 these two broads had an interesting bottom flora of filamentous green algae. A survey of the forms present showed that each area sampled had a dominant filamentous alga with only occasional filaments of the other types which were present in the Wheatfen waters.

Genera examined were:

| | |
|---|---|
| Fen Channel | *Cladophora* |
| Sides of Fen Channel | *Spirogyra* |
| Lilies in Fen Channel | *Enteromorpha* |
| Deep waters north side | *Enteromorpha* |
| Deep waters south side | *Vaucheria* |
| Deep waters west end | *Cladophora* |
| Wheatfen Broad | *Spirogyra* |

The Cladophora was almost certainly *Cladophora glommerata* but branching was very rare. It was covered with epiphytic diatoms. The Enteromorpha was a very slender form with a great deal of branching. There were two species of *Spirogyra* present, neither of which could be identified with certainty. The larger of the two species was grown on to produce zygotes and it did not agree with any of the species for which we had descriptions ( Pascher 1932 ). It was closest to *Spirogyra elipsospora* Transeau a species which has been incompletely described and only known from North America.

Recently a list of Wheatfen algae for 1939 has come to light in the field notes of E.A. Ellis. The observations there are consistent with the situation at the present day.

**Aquatic Plants**

Prior to 1991 submerged aquatic plants were confined to remote dykes (The Smee Dykes) where river water only gained access after passing across areas of carr and reedbed. Here there were good crops of *Ceratophyllum* and *Elodea*, accompanied by invertebrates. The water in these dykes was clear with a low turbidity. During 1993

t was noticed that small areas of Starwort were occurring in the tidal dykes and in subsequent years these areas of Starwort increased considerably both in size and distribution. *Elodea* began to grow in some of the main dykes in 1994.

Some areas of *Nuphar* in the Fen Channel had never been completely eliminated and these increased in size during 1993-1995.

### Cladocera

Ninety years ago Gurney carried out a survey of Cladocera in Surlingham and Rockland Broads (Gurney 1904) in which he noted the presence of 13 taxa in Surlingham Broad and 17 taxa in Rockland At various times between 1952 and 1990 attempts were made to collect Cladocera at Wheatfen with little success. Only in the Smee Dykes was it possible to make a decent collection, although here the commonest Cladoceran was *Daphnia pulex*, a species not noted by Gurney from the area. However in August 1994 a survey was carried out which resulted in finding 16 taxa at Wheatfen. Further sampling has now increased this number to 20.

### Mollusca

For many years it has been rare to find a specimen of the Zebra mussel in the Broads, although in the immediate post-war period they occurred in such numbers as to cause difficulties in the raw water mains of the Yarmouth Waterworks (Clarke 1953). Over the last few decades it has returned to Oulton Broad and surprisingly enough has recently been found in Rockland Dyke and on stones at the Old Ford in the main channel at Wheatfen. So far the abundant aquatic snail fauna has not returned to Wheatfen. Its disappearance in mud cores at Wheatfen provides a distinct and dateable horizon (Ives 1990)

## Discussion

The comparison of chemical results between the river and Wheatfen produced no surprises except with the Total Oxidised Nitrogen. It will be seen from Table 2 that this determinand is close to Nitrate. Why the values at Wheatfen should be so much lower than the river is a mystery. It may be that the fact that extensive mud pumping had been carried out at Wheatfen the previous summer and autumn had some influence on the lowering of TON. The Brundall Broads had been reexcavated immediately before the study by Leah et al (1980) and although it was not mentioned in the paper, the graphs of nitrate nitrogen (their Fig 4) shows that the inner broad had considerably less nitrate through the spring and early summer, even at times when chlorophyll a values were low in the inner broad. It would be interesting to have more data about the drop of nitrates at Wheatfen.

The return of Cladocera is very encouraging but too much should not be made of the higher numbers of species found recently when compared to Gurney's list. The difference from Gurney probably reflects difference in sampling effort: his list was the product of a single visit while the recent list is based on perhaps 20 collections

from the Wheatfen reserve. Although the green filamentous algae provide a refuge for Cladocera, the return of most species preceded the growths of green filamentous algae.

At Brundall Broads which were studied by Leah et al( 1980) the Inner Broad had only connection with the river from a drainage dyke which was occasionally flooded and leaked through a dam into the Inner Broad. Early in their study the Inner Broad exhibited the same changes which are now being noticed at Wheatfen. An early change, which was also noted at Wheatfen, was that the bottom of the Inner Broad became covered with green filamentous algae.

The Smee dyke at Wheatfen is somewhat analogous to the Inner Broad at Brundall because the access of tidal water is indirect. Just as the Inner Brundall Broad, after cleaning out in the 1980s the Smee Dyke developed a population of macrophytes (*Ceratophyllum demersum*, *Enteromorpha* sp.,*Lemna trisulcata*, *Callitriche stagnalis*, ) and *Daphnia*.

The lack of change in the diatom populations is not really surprising when we look at the nutrient situation. There was no radical change in the availability of nutrients, nitrogen, phosphorus and silica as a result of the improvements at Whitlingham Sewage Treatment works. There was a change in the form of nitrogen present in the river, a considerable lowering of ammonia levels. These fell so as to reduce their toxicity to invertebrates but not so much as to deprive diatoms of nutrients. There has nowhere been any sign that ammonia levels sank to a level where diatom growth would be restricted. In any case, many diatoms are capable of using nitrate as a nitrogen source.

Some of the improvements in the quality of the River Yare water were noticed before the commissioning date of the Whitlingham improvements. This date was, however the completion date for the work. Various parts of the improvements were actually brought into use during 1991, beginning some six months before the official completion date.

**Summary**

The apparent improvements in water quality at Wheatfen have been borne out by chemical results. These improvements had already been noted by the National Rivers Authority in respect of the River Yare.

The greatest changes have been the reduction in turbidity and a drop in ammonia which are having an effect on aquatic animals and plants.

**Acknowledgements**

The authors are grateful to Anglian Water for analysing the 1995 series of samples and to the National Rivers Authority, especially Steve Hopper and Peter Fountain who helped with abstraction of data from the Control of Pollution Act Register at Peterborough. They are grateful to the University of East Anglia and to Essex and

uffolk Water for the use of their laboratory facilities. The search of the Field Notes of .A. Ellis was made by Dr. R. E. Baker

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# *AULACOSEIRA EPIDENDRON* (EHRENB) CRAWFORD A NEW RECORD FOR NORFOLK FROM WHEATFEN

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## Introduction

In revising Fred Kitton's list of the Norfolk Diatomaceae (Kitton 1884) we have already covered about 600 taxa and are now looking for the rarer diatoms. One of these is what Kitton called *Liparogyra spiralis* Ehrenberg and which is probably what is now known as *Aulacoseira dendroteres* (Ehrenb) Crawford. Kitton found it "In washings of Moss taken off the trunk of an Elm on Earlham Road, Norwich. "

## Materials & Methods

The elms on Earlham Road, successors to those of Kitton's day were examined without finding any diatoms. Indeed moss is distinctly rare. Up to now this is a

lost species for Norfolk. It seemed worthwhile examining the mosses at Wheatfen. Kitton examined many moss samples from Heigham Alder Carr (now the site of the Inner Ring Road roundabout ) without recording any "tree-living" *Aulacoseiras* there.

First examination of moss from Wheatfen was disappointing from the point of view of moss-dwelling diatoms. The mosses examined were immersed from time to time in tidal water. Diatoms were abundant but they were mostly planktonic or benthic diatoms from the Wheatfen waters. (Clarke 1960)

Recently an area of alders at the south-east corner of Alder Carr at Wheatfen has become accessible and moss was collected from the bottom of the trunks. This is an area remote from regular tidal inundation and the moss contained several subaerial diatoms. Among these were a few "tree-living" *Aulacoseiras* . But they were not *Aulacoseira dendroteres.* They were a close relation, another member of the *Orthoseira roeseana* complex of Houk (1993) the equally fascinating *Aulacoseira epidendron* (Ehrenb) Crawford. This species has never been reported before from Norfolk.

The alders were about 20 years old, spaced about 4 m apart. overgrown with a layer of 15 mm of moss for a height of 800 mm above the peat soil. Moss was carefully picked off to minimise the amount of rotted bark included in the sample. On return to the laboratory the moss was squeezed repeatedly in distilled water. The resultant liquid was boiled for 30 minutes with nitric acid in a fume chamber. After repeated washings the cleared diatom suspension was mounted in Naphrax.

**Results**

The cells of *Aulacoseira epidendron* found on the slide were rare, less than 1% of the diatoms present. They were not usually united into chains in the prepared material. Valve diameter was 9 mm which is very low, considering that the size range is given as 8 mm to 70 mm by Krammer and Lange-Bertalot (1991) and even 10 mm to 50 mm by Crawford (1981). The cells were about 17 mm long. Only one pair of attached sibling valves were observed.One half frustule lay obliquely on the slide and this allowed the valve face and valve-mantle junction to be observed. The valve edge is decorated with small teeth and in the centre of the valve are three large pores which Crawford (1981) has called carinoportulae. The valve mantle is distinctly punctate with puncta lying parallel to the apical axis. The whole frustule is feebly silicified and this is especially marked in the girdle bands. No trace could be seen of the ligulate nature of these bands but a single row of puncta could be made out at the edge of a girdle band.

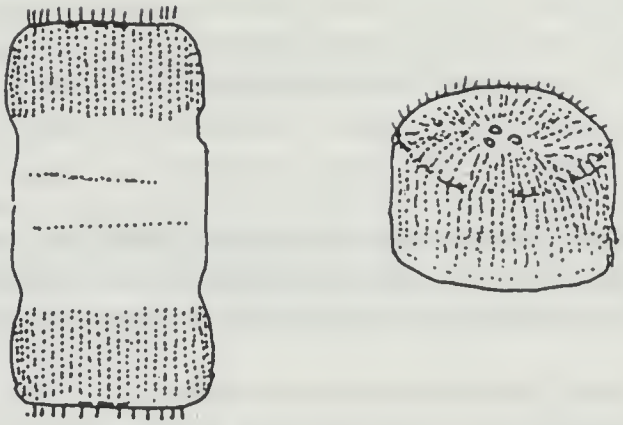

**Figure1.** *Aulacoseira epidendron* (Ehrenb) Crawford from moss at Wheatfen. (a) Frustule containing two valves and girdle bands measuring 9 µm diameter and 17 µm long. (b) Valve and valve mantle viewed obliquely

## Discussion

*Aulacoseira epidendron* (Ehrenb) Crawford has been mostly reported from acid rocks and from shady places. The part of Alder Carr at Wheatfen where the diatom was found was covered with close-grown trees of about 500-800mm girth. This is a situation of deep shade during much of the year. Ground level at this point is about high water level of spring tides so that the soil consists of waterlogged peat. There is little ground cover vegetation. Krammer & Lange-Bertalot state that the diatom is more common in the mountains and only occasional in the lowlands.

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# THE BROADLAND FEN RESOURCE SURVEY, 1991-1994
# A BRIEF SUMMARY

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## Introduction

Broadland is important for four types of wetland habitat: the broads themselves, the rivers that flow through the area, the reclaimed marshes with lowland wet grassland and associated dyke systems, and the undrained open fens and carr woodland.

The c.2500ha of fen in Broadland represent the largest expanse of fen vegetation in lowland Britain and are of great national and international importance. The ecological significance of the Broadland fens has long been recognised and a large proportion of the area has been scheduled as Sites of Special Scientific Interest, Ramsar Sites or Special Protection Areas, or included in National Nature Reserves or other types of reserve (see Table 1).

The scientific study of the Broadland fens has a long history. This research has included studies of the plant communities, vegetational succession, management and peat stratigraphy, as well as descriptions of the vegetation at individual sites.

Marietta Pallis carried out her pioneering studies of fen vegetation in the early part of the twentieth century and wrote the chapter on Broadland fens in Tansley's *Types of British Vegetation* (1911). After apparently abandoning botanical research for many years she returned to Broadland and recorded her theories about fens in a series of privately printed pamphlets between 1956 and 1963 (Stearn 1986).

After the Second World War, Joyce Lambert and John Jennings studied the succession from open water to carr woodland (Lambert 1951, Lambert & Jennings 1951, Jennings & Lambert 1951). Their investigations of stratigraphy were instrumental in showing that the broads were artificial waterbodies (Lambert *et al.*1960).

Bryan Wheeler studied the vegetation at a number of fen sites in Broadland during the early 1970s (Wheeler 1975) and has continued to be involved in research in the area since this time.

Several studies of the vegetation at particular sites have been carried out, e.g. Surlingham/Rockland (Lambert 1946), Rockland/Claxton (Lambert 1948), Catfield (Giller 1982).

Reflecting the increased concern about the loss of, and damage to, fen communities at many sites, some of the more recent research has focused on the management of fens to maintain and enhance their ecological interest, e.g. Wheeler (1984a), or on the factors causing their deterioration, e.g. Gilvear *et al* (1990).

As well as being studied in their own right, the Broadland fens were included in two major aerial photographic surveys of Broadland. In1980 the Nature Conservancy Council, the University of East Anglia and the Broads Authority jointly commissioned the Institute of Terrestrial Ecology (ITE) to carry out a vegetation survey of Broadland based on aerial photography. The final report and maps revealed the location and extent of undrained fen within the Broads Authority executive area but did not examine the vegetation in detail (Fuller 1984). In 1988 Norfolk County Council commissioned an aerial photographic survey of the whole of Norfolk (a complete set of photographs is held by the Department of Planning and Transportation, County Hall).

In recent years it has generally been recognised that a comprehensive survey of the Broadland fens was needed. Wheeler (1984b) suggested that such a survey should identify the area and distribution of the vegetation types, collate the existing information, identify the most important stands of vegetation and ultimately lead to the development of appropriate management strategies for particular plant communities and sites. Since then several surveys with more restricted aims have included a selection of Broadland fens, e.g. Fojt (1990), Shaw & Wheeler (1990), Wheeler & Shaw (1987,1992a,1992b).

In 1991 English Nature and the Broads Authority commissioned a major survey of the Broadland fens from the Environmental Consultancy of the University of Sheffield (ECUS). The project aimed to survey the distribution of fen vegetation communities in Broadland, produce an inventory of past and present management practices, record the distribution of locally or nationally rare and scarce plants, investigate some of the environmental variables associated with each vegetation type and site, and produce a report that would describe the sites and indicate communities or species of particular interest. The remainder of this paper summarizes the coverage and results of this survey.

## Methods

Sites for study were selected in several ways. Open fen sites were identified using the ITE maps based on the 1980 aerial photographs of Broadland and the colour photographs taken for Norfolk County Council in 1988. Additional sites were selected on the basis of their known ecological interest, historical botanical records or recommendation by other workers.

In order to make description and mapping easier, large sites were divided into subsites for study. These were further divided into fen compartments.

The vegetation was recorded at the majority of sites using a technique similar to the standard English Nature 'Phase II' methodology (Fojt 1991). Within each compartment 2m x 2m quadrats were recorded in homogeneous stands of recognisably different vegetation. Waterlevel, percentage cover of higher plants, bryophytes, litter and bare earth, and the height of the vegetation were also recorded. Additional species were recorded from 100m2 areas centred on the quadrats. The gross stratigraphy of the upper 1.5m of substratum was recorded at selected locations using a Hiller borer and samples of peat were collected for analysis, including pH, electrical conductivity and phytometric fertility.

Published and unpublished sources were searched for botanical records and information about management. The most useful sources were the *Transactions of the Norfolk and Norwich Naturalists' Society* and other local natural history society journals, and the herbarium and archives in the Natural History Department, Castle Museum, Norwich.

## Results

The survey included a total of 122 fenland sites, which were grouped into 57 study areas. Figure 1 shows the location of the study areas and Table1 gives details of the sites.

All of the sites were surveyed using the same technique and the survey was carried out over a relatively short period of time (3 years), making it possible to compare the results from different sites with confidence.

The vegetation was recorded in 1670 quadrats. Quadrats were not recorded at a number of sites, either because the site no longer supported fen vegetation or, in a few cases, because access was refused or livestock made sampling impossible. The quadrat data were used in a variety of ways.

The National Vegetation Classification (NVC) sets out to describe and classify the natural and seminatural vegetation types that are found in Great Britain (Rodwell 1991 *et seq.*). As a first stage in the analysis of the survey results, the quadrats were subjectively assigned to NVC communities. A computer program, Match (Malloch 1988), was also used to classify the quadrat data according to the NVC. This produced results that were very similar to the subjective classification.

It soon became apparent that the variation in Broadland fen vegetation was not adequately described by the NVC. Another computer program, TWINSPAN (Malloch 1988), was used to develop a classification of Broadland fen vegetation based on the quadrat species lists. This new classification recognised 53 different fen communities. Some of these were common and widely distributed. Others were less common and a few were found at single locations. In order to place the Broadland fens in a national context, the Broadland fen communities were compared

with those of the NVC.

A species list and a list of the Broadland and NVC vegetation classes present and their areas were prepared for each site and for each river valley. A written description, including a summary of the environmental data, and a review of historical information were prepared for each site.

A series of maps was prepared for each site at a scale of 1:2500 showing vegetation types, large non fen features, including scrub, carr and water bodies, and the location of quadrats.

A second series of maps was prepared at a scale of 1:10000 showing pH, substratum fertility, electrical conductivity of the soil water, the location of core cores (including data from other surveys), former turf ponds, contemporary experimental 'turf ponds', land use c.1885 and c.1907, the condition of the dyke system, access to the site, the location of locally and nationally rare and scarce plants recorded since 1980 and contemporary management.

The results of the survey have been written up for English Nature and the Broads Authority in a series of published and unpublished reports. The published report contains an account of the survey methodology, detailed descriptions of the vegetation at each site, along with historical information and environmental data, descriptions of the Broadland fen communities, and an evaluation of the fen resource within local, regional, national and international frameworks (Parmenter 1995a). The report also contains a key that can be used to classify further samples of fen vegetation in Broadland. The unpublished reports provide further analysis and discussion of some aspects of the survey results (Parmenter 1995b, 1995c, 1995d).

The original quadrat data, maps and target notes for each site form a large and valuable archive (Parmenter 1991-1994). It is intended that a copy of this archive will be deposited in the Natural History Department, Castle Museum, Norwich.

## Discussion

The undrained fens associated with the Norfolk Broads have long been recognised as an important wetland habitat. Despite this, there has never been a comprehensive botanical survey of the Broadland fens. The present survey has produced an up to date description of each site and brought together a great deal of historical information. The survey has also produced a detailed classification and description of the fen vegetation found in Broadland.

The survey results will be used in several ways. The descriptions of individual sites and the classification of fen vegetation will be used in the formulation of a strategy for the management and conservation of fen sites and fen vegetation types in Broadland. In the short term the results of the survey indicate the sites and vegetation types which are suitable for management trials or where further

investigation may be of value. In the longer term the survey results should serve a a base line for monitoring changes in the fen vegetation, including the results o management.

A large proportion of the survey data, as well as information from other sources has been transferred to SPANS, a geographical information system (GIS). Thi should make the information more accessible and will make it possible to use th data in other ways. SPANS has already been used to produce distribution maps fo individual species (Parmenter 1995c).

**Acknowledgements**

English Nature and the Broads Authority funded the survey. A large number of individual and organisations provided practical help, information or allowed access to their lan and they have been fully acknowledged in the final report. Although lack of space means that they cannot all be listed here, Bryan Wheeler, of the University of Sheffield, wh supervised the project, and Gary Kennison, scientific officer with the Broads Authority who gave a great deal of practical help, must be singled out for particular thanks. Clive Doarks read a draft of this paper and suggested a number of improvements. Tony Irwin converted the original LocoScript files into a more accessible form.

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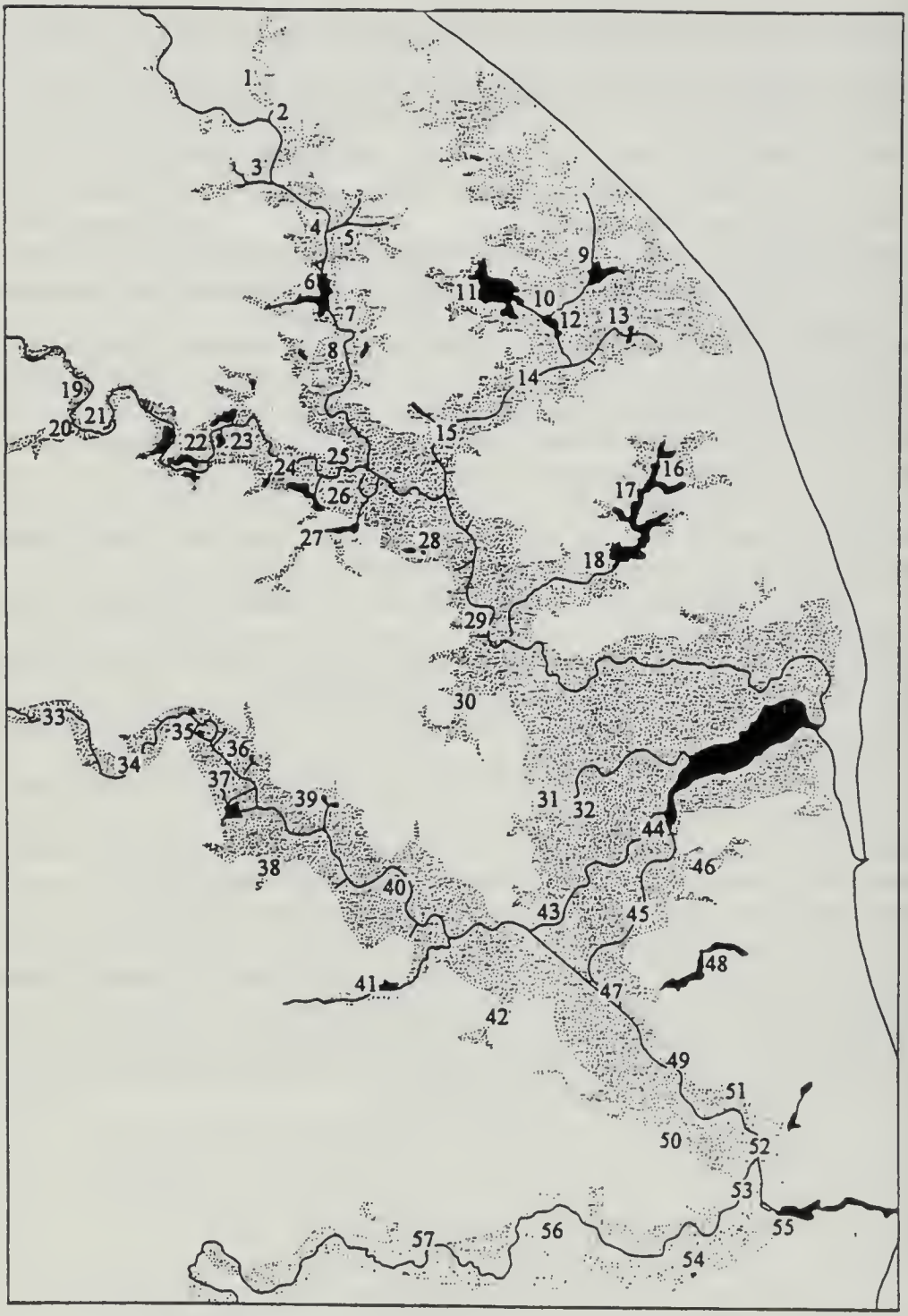



Figure 1. Map of Broadland showing the approximate locations of the study areas.

Table 1. List of sites included in the Broadland Fen Resource Survey, 1991-1994.

| Site no.[1] | Site name[2] | Status[3] | Historical dossier[4] | Surveyed in[5] | Quadrat data[6] | Site description[7] |
|---|---|---|---|---|---|---|
| 1 | East Ruston Common - King's Fen | SSSI | 3201A | 1991 | - | 1 |
| | East Ruston Common - Mown Fen | SSSI | 3201B | 1991 | • | 1 |
| | Honing Common | - | 3201C | 1991 | • | 2 |
| | Dilham Broad | - | 3201D | 1991 | - | 2 |
| 2 | South Fen & The Holmes | - | 3202 | 1991 | • | 3 |
| 3 | Broad Fen, Dilham | SSSI | 3203A | 1991 | • | 4 |
| | Smallburgh Fen | SSSI | 3203B | 1991 | • | 5 |
| 4 | Stalham Fens | - | 3204A | 1991 | • | 6 |
| | Common Fen, Berry Hall Fens, Mallow Marsh & Barton Turf | SSSI/NNR | 3204B | 1991 | • | 6 |
| 5 | Chapelfield Marshes | SSSI | 3205A | 1991 | • | 7 |
| | Sutton Broad Fen | SSSI | 3205B | 1991 | • | 7 |
| | Hand Marsh | SSSI | 3205C | 1991 | • | 7 |
| | Sutton Fen | SSSI/NNR | 3205D | 1991 | • | 7 |
| 6 | The Heater | SSSI/NNR | 3206A | 1991 | • | 8 |
| | Barton Hall Fens | SSSI/NNR | 3206B | 1991 | • | 8 |
| 7 | Catfield Fen - North, Middle & South Marshes & Rose Fen | SSSI | 3207A | 1991 | • | 9 |
| | Catfield Fen - Sedge Fen, Fenside & Reed Marshes | SSSI | 3207B | 1991 | • | 9 |
| | Catfield Fen - Irstead Fen | SSSI | 3207C | 1991 | • | 9 |
| | Catfield Fen - Great & Little Fens & Moores Head Marsh | SSSI/NNR | 3207D | 1991 | • | 9 |
| 8 | Snipe Marsh | SSSI | 3208A | 1991 | • | 10 |
| | Sharp Street Fens | SSSI | 3208B | 1991 | • | 10 |
| | Clayrack Marshes | SSSI | 3108C | 1991 | • | 10 |
| | Hall Fen | SSSI | 3208D | 1991 | • | 10 |
| | Reedham Marshes | SSSI | 3108F | 1991 | • | 10 |
| | Little Reedham | - | 3108G | 1991 | • | 10 |
| | Alderfen | SSSI | 3108E | 1991 | • | 11 |
| 9 | Brayden Marshes | SSSI | 4209A | 1993 | • | 12 |
| | Horsey Mere | SSSI | 4209B | 1993 | • | 12 |
| | Horsey Marshes | SSSI/NNR | 4209D | 1993 | • | 12 |
| | Long Gore Marsh | - | 4209C | 1993 | • | 13 |
| 10 | Whiteslea & Meadow Dyke | SSSI/NNR | 4210A | 1993 | • | 14 |
| | Skoyles & 100 Acre Marsh | SSSI/NNR | 4210B | 1992 | • | 14 |
| 11 | Hickling Broad Marshes | SSSI/NNR | 4211A | 1993 | • | 15 |
| | Mrs Myhills Marsh | SSSI | 4211B | 1993 | • | 16 |
| 12 | Heigham Sound & Meadow Dyke | SSSI/NNR | 4212A | 1993 | • | 17 |
| | Sound Marshes | SSSI/NNR | 4212B | 1993 | - | 17 |

Table 1 continued.

| Site no.[1] | Site name[2] | Status[3] | Historical dossier[4] | Surveyed in[5] | Quadrat data[6] | Site description[7] |
|---|---|---|---|---|---|---|
| 13 | Mere Farm Marshes | SSSI | 4213A | 1993 | • | 18 |
| | Martham Broad Marshes | SSSI | 4213B | 1992 | • | 19 |
| 14 | Potter Heigham Fen | SSSI/NNR | 4114A | 1992 | • | 20 |
| | Martham Marshes | - | 4114B | 1993 | - | 21 |
| 15 | Womack Water Marshes | SSSI | 3115A | 1992 | - | 22 |
| | Shallam Dyke | - | 4115B | 1992 | - | 23 |
| 16 | Ormesby Common | - | 4116A | 1992 | - | 24 |
| | Ormesby Broad & Decoy Wood | - | 4116B | 1992 | - | 24 |
| | Hall Farm Fen, Hemsby | SSSI | 4116C | 1992 | • | 25 |
| 17 | Rollesby Broad | - | 4117 | 1992 | • | 26 |
| 18 | Burgh Common | SSSI | 4118A | 1992 | • | 27 |
| | Filby Broad | - | 4118B | 1992 | - | 28 |
| 19 | Coltishall Marsh | - | 2119A | 1992 | - | 29 |
| | Blackmans Fen | - | 2119B | 1992 | • | 29 |
| 20 | Crostwick Marshes | SSSI | 2120A | 1992 | • | 30 |
| | Dobbs Beck Marshes | - | 2120B | 1992 | • | 30 |
| 21 | Belaugh & Wroxham Marshes | - | 2121A | 1992 | • | 31 |
| | Jubys Farm Marshes | - | 2121B | 1992 | • | 31 |
| 22 | Snapes Water | - | 3122A | 1992 | - | 32 |
| | Hoveton Marsh & Sedge Fen | SSSI/NNR | 3122B | 1992 | • | 33 |
| | Wroxham & Salhouse Marsh | - | 3122C | 1992 | • | 34 |
| 23 | Woodbastwick Marshes | SSSI/NNR | 3123A | 1992 | • | 35 |
| | Hoveton Little Broad & The Lows | - | 3123B | 1992 | • | 36 |
| 24 | Ranworth Broad Marshes | SSSI/NNR | 3124A | 1992 | • | 37 |
| | Horning Church Marshes | SSSI | 3124B | 1992 | • | 38 |
| | Ferry Road Fen | SSSI/NNR | 3124C | 1992 | • | 39 |
| 25 | Horning Hall Marshes | SSSI | 3125A | 1992 | • | 40 |
| | Hulver Ground | - | 3125B | 1992 | • | 41 |
| 26 | Ranworth Marshes | SSSI | 3126A | 1992 | • | 42 |
| | Ward Marsh | SSSI | 3126B | 1992 | • | 42 |
| 27 | Ranworth Flood & Leists Marsh | SSSI | 3127A | 1992 | • | 43 |
| | South Walsham Fen & Sotshole Carrs | LNR | 3127B | 1992 | • | 44 |
| 28 | Upton Fen & The Doles | SSSI | 3128 | 1992 | • | 45 |
| 29 | Acle Carrs | - | 4129A | 1992 | - | 46 |
| | Fishley Carrs | - | 3129B | 1992 | - | 47 |
| 30 | Decoy Carr, Acle | SSSI | 4030 | 1992 | • | 48 |

Table 1 continued.

| Site no.[1] | Site name[2] | Status[3] | Historical dossier[4] | Surveyed in[5] | Quadrat data[6] | Site description[7] |
|---|---|---|---|---|---|---|
| 31 | Halvergate & Wickhampton Marshes | SSSI | 4031 | 1993 | • | 49 |
| 32 | Wickhampton Marshes | SSSI | 4032A | 1993 | - | 50 |
| | The Fleet Marshes | - | 4032B | 1993 | - | 50 |
| 33 | Whitlingham & Thorpe Marshes | - | 2033 | 1993 | • | 51 |
| 34 | Surlingham Church Marshes | SSSI | 3034A | 1993 | • | 52 |
| | Postwick Marshes | - | 3034B | 1993 | - | 53 |
| | Kirby Marshes | - | 2034C | 1993 | • | 54 |
| 35 | Surlingham Broad Marshes | SSSI | 3035A | 1993 | • | 55 |
| | Bargate & The Outmeadows | SSSI | 3035C | 1993 | - | 55 |
| | Brundall Carrs & Marshes | - | 3035B | 1993 | - | 56 |
| 36 | Bradeston & Strumpshaw Marshes | SSSI | 3036A | 1993 | • | 57 |
| | Strumpshaw Common | SSSI | 3036B | 1991 | • | 57 |
| 37 | Surlingham Marsh | SSSI | 3037A | 1993 | • | 58 |
| | Wheatfen & Rockland Marshes | SSSI | 3037B | 1993 | • | 58 |
| 38 | Ducan's Marsh, Claxton | SSSI | 3038A | 1993 | • | 59 |
| | Carleton Broad | - | 3038B | 1993 | - | 60 |
| 39 | Buckenham & Hassingham Carrs | SSSI | 3039A | 1993 | • | 61 |
| | Buckenham & Hassingham Ronds | - | 3039B | 1992 | • | 62 |
| 40 | Poplar Farm Marshes | SSSI | 3040A | 1993 | • | 63 |
| | Limpenhoe Marshes | SSSI | 3040B | 1993 | - | 64 |
| | Cantley Ronds | - | 3040C | 1992 | • | 65 |
| 41 | Hardley Flood | SSSI | 3941A | 1993 | - | 66 |
| | Chedgrave & Loddon Commons | - | 3941B | 1993 | - | 67 |
| 42 | Thurlton Beck Marshes | - | 3942 | 1993 | - | 68 |
| 43 | Reedham Ronds | - | 4043 | 1992 | • | 69 |
| 44 | Glebe Marshes | SSSI | 4044A | 1993 | • | 70 |
| | Burgh Castle Ronds | - | 4044B | 1992 | • | 70 |
| 45 | Belton Ronds | - | 4045 | 1992 | • | 71 |
| 46 | Belton Bog & Bradwell Doles | - | 4046 | 1993 | • | 72 |
| 47 | Fritton & St Olaves Ronds | - | 4047 | 1992 | • | 73 |
| 48 | Fritton Decoy | - | 4048A | 1993 | - | 74 |
| | Ashby Warren | - | 4048B | 1993 | - | 74 |
| 49 | Herringfleet Ronds | - | 4949 | 1992 | • | 75 |
| 50 | Wheatacre Marshes | - | 4950 | 1993 | - | 76 |

Table 1 continued.

| Site no.[1] | Site name[2] | Status[3] | Historical dossier[4] | Surveyed in[5] | Quadrat data[6] | Site description[7] |
|---|---|---|---|---|---|---|
| 51 | Flixton Decoy | - | 5951A | 1993 | • | 77 |
| | Summerhouse Water | - | 4951B | 1993 | - | 77 |
| 52 | Somerleyton & Blundeston Ronds | - | 4952 | 1992 | • | 78 |
| 53 | Burgh St Peter Ronds | - | 4953 | 1992 | • | 79 |
| 54 | Barnby Broad & Marshes | SSSI | 4954A | 1993 | • | 80 |
| | North Cove & Wadehall Marshes | SSSI | 4954B | 1993 | • | 80 |
| | Seven Mile Carr | - | 4954C | 1993 | - | 81 |
| 55 | Oulton Marshes | - | 5955A | 1991/3 | • | 82 |
| | Whitecast Marshes | SSSI | 5955B | 1993 | • | 83 |
| | Sprats Water | SSSI | 5955C | 1993 | • | 84 |
| 56 | Beccles Marshes | - | 4956A | 1993 | • | 85 |
| | Wild Carr, Worlingham | - | 4956B | 1993 | - | 86 |
| | Stanley & Alder Carrs | SSSI | 4956C | 1993 | • | 87 |
| 57 | Roos Hall Marsh | - | 4957A | 1993 | - | 88 |
| | Barsham Marshes & Low Meadows | - | 4957B | 1993 | - | 89 |
| | Geldeston Marshes | - | 3957C | 1993 | • | 90 |

1 Numbers refer to sites or groups of sites indicated on Figure 1.

2 Many sites do not have generally accepted names. The names given here are those used in the historical dossiers.

3 An entry here indicates the status of all or part of a site:
LNR Local Nature Reserve.
NNR National Nature Reserve.
SSSI Site of Special Scientific Interest.

4 Historical dossier reference number (The reference numbers are derived from the O.S. 10km grid square and the number of the site or group of sites. The letters indicating the 100km grid square have been omitted due to lack of space).

5 Year in which most of the survey work was carried out (some sites were visited in more than one year).

6 Quadrat data were not collected at all sites. • indicates that quadrat data were collected.

7 Sequential numbers (used in this table only). Site descriptions that include more than one site are indicated by repeating the number, e.g. Honing Common and Dilham Broad were described in a single contemporary site description.

# WEATHER REPORT 1995

J.G.Hilton
Morley Research Centre Wymondham

The year was warmer than normal but not as warm as 1994. Rainfall (613.4 mm) was equal to the long-term mean and sunshine (1704.7 hours) was the highest since 1990.

**January** was the coolest for three years, but the mean temperature was still above the long term normal. It was the wettest since 1988. The first four days were dry, sunny but cold. The rest of the month was characterised by periods of strong westerly winds with mild temperatures and periods of heavy rain interspersed with spells of cooler, drier and sunnier weather.

**February** was the wettest since 1958, but the sunniest since 1988 and the mildest for five years. Maximum temperatures exceeded 10°C on 11 days, and only two air frosts of -1.0°C were recorded.

**March** was the sunniest since 1982 but rainfall was well above normal. The mean temperature was the lowest for eight years.

**April** was the driest since 1984 and the sunniest for four years. The mean temperature was 0.9°C above normal. The first significant rain fell on the 17th (2.6 mm) followed by the 18th (3.6 mm). Air frosts occurred on four nights during the fourth week.

**May** was the driest for for four years and the sunniest for three. The maximum temperature of 26.8°C on the 5th was the warmest day in May since 1947, but temperatures were below normal from the 8th to the 21st.

**June** was the coolest, dullest and wettest for four years, but rainfall was below the 226 year average. The first half of the month was cool with heavy showers, but spells of warmer weather were recorded during the second half.

**July** was 2.3°C above normal, but it was not as warm as July 1994. Rainfall was the lowest and sunshine the highest since 1991. The first four days were cool, wet and dull but, for the rest of the month, mostly above normal temperatures prevailed. Maximum temperatures exceeded 25°C on 17 days and 30°C was reached twice.

**August** was the warmest and sunniest since 1990 and the driest since 1983. N appreciable rain fell for the first 25 days. 25°C was exceeded on 15 days. Rain wa recorded on the last six days of the month

**September** was much wetter and cloudier than normal, but not as extreme a 1994. Rain fell on all but three days and heavy falls of 11.8 mm (2nd), 26.6 mm (15th) and 16.8 mm (17th) were recorded together with more than 5 mm on each o another five days.

**October** was the warmest since 1969 and the driest since 1985. It was the cloudiest for four years. The maximum temperature did not fall below 15°C unti the 20th and the recording of 24.6°C on the 9th was the warmest October day fo ten years.

**November** was much drier and cloudier than normal but the mean temperature was 1.0°C above the 26 year mean.

**December** was the coldest since 1981 and the dullest since 1989 with only 14 sunny days. Temperatures were mostly below normal for much of the month; apart from a few milder spells. They began to fall on the 23rd, heralding a period of very cold weather with extreme frosts, -10.5°C on the 28th and -12.4°C the next day

Figure 1. *Monthly mean temperature 1995*

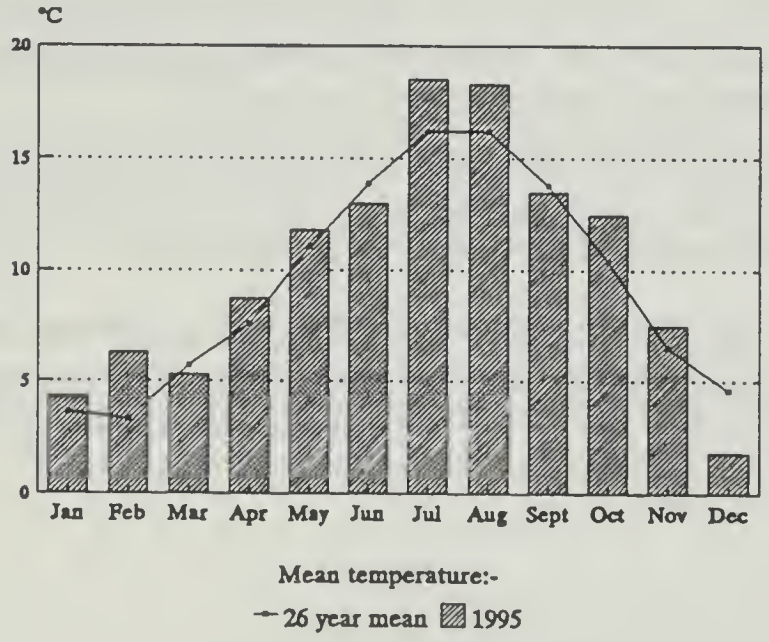


Figure 2. *Monthly rainfall 1995*

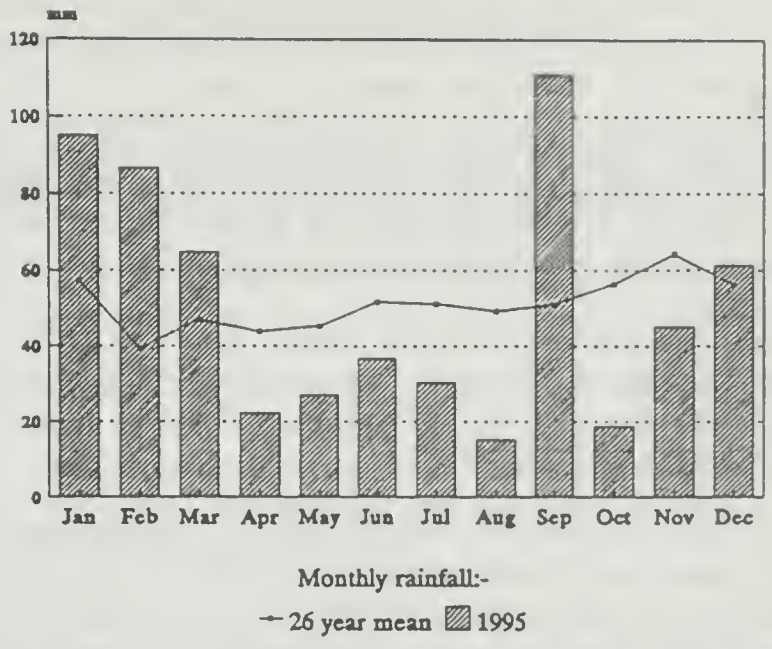
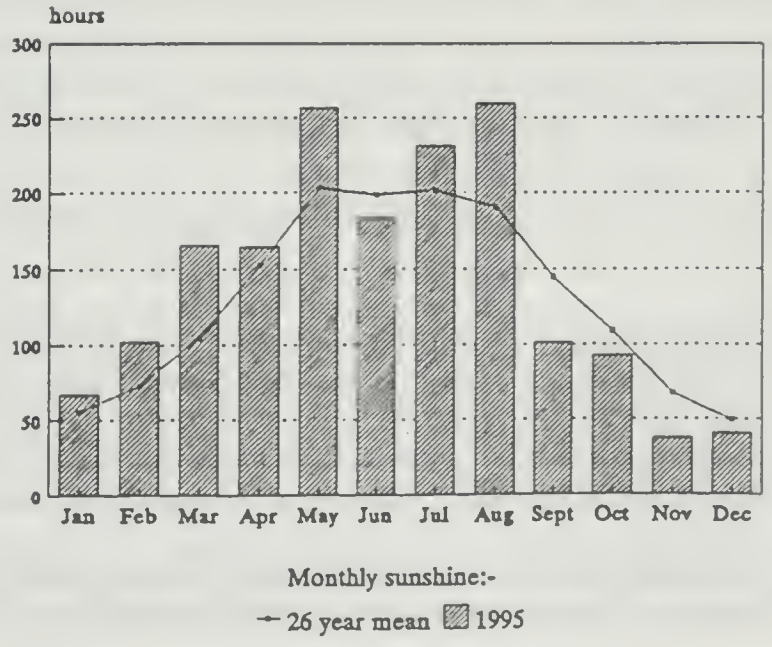



Figure 3. *Monthly sunshine 1995*



# THE VEGETATION AT HONING COMMON: A CENTURY OF CHANGE

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## Introduction

Agriculture is one of the major factors influencing the rural landscape of lowland Britain. Much of the land is actively farmed and a large proportion of the remainder was farmed in the past. A small proportion of the land is currently unmanaged and only a very small area is truly natural (i.e. it has never been managed).

The 20th century has seen unprecedented changes in British farming. Technological advances, the perceived need to make Britain self sufficient in certain food stuffs, and changes in the way in which agriculture is financed, have all had a role in changing the way that land is managed.

These changes have involved the intensification of management of land already farmed, e.g. ploughing up grassland and removing ditches and hedgerows (Broadland Friends of the Earth 1984, Driscoll 1983, Baird & Tarrent 1973), and the reclamation of natural and semi-natural habitats to increase the area farmed, e.g. ploughing up heathlands, draining marshland (Shoard,1980).

Although often less obvious, because the changes are not usually so rapid, the loss of managed habitats due to the demise of traditional management practices and subsequent neglect is also significant. Grassland sites in particular suffer when there is a cessation of management for whatever reason. Scrub rapidly invades open lowland habitats and they can succeed to young woodland within as little as 25 years. Ironically, at the same time that people have been bemoaning the loss of woodland (especially ancient woodland) and the loss of lowland trees in general, large areas of herbaceous vegetation have been lost through scrub encroachment. In most cases, the woodland that develops on these sites lacks the interest of 'ancient' woodland and is of a lower conservation value than the open habitat which it replaces.

In the post-medieval period, a large proportion of lowland Britain was farmed in an open field system, which, contrary to popular imagination, would have left little room for wildlife habitats and open semi-natural vegetation within the frame work of the farmed landscape. Natural and semi-natural vegetation would have been restricted to discrete, albeit extensive, areas of woodland and common pasture.

The common land that remains is still valuable for the semi-natural habitats that it contains, although in many cases this value has declined through lack of

management.

The many ecological surveys which have been carried out in Great Britain over the last quarter of a century provide a detailed account of the habitats studied and can be used as baselines to monitor future changes. Such systematic surveys are a very recent phenomenon. For example, a review of biological surveys of ditches in England and Wales listed over 280 surveys carried out up until 1995 (Driscoll in press). Less than 10 of these had been carried out before 1970, and only 1 before 1950! Reviews of other habitats would almost certainly produce similar results. This lack of historical records means that it is rarely possible to provide a detailed account of the habitat changes that have taken place at a particular site.

Despite this lack of old survey data, there is a great deal of anecdotal evidence to suggest that lowland open habitats have been lost as a result of scrub invasion.

The Town Land at Honing (TG 328276) is an example of a site where there is good evidence of vegetation change. A botanical survey of this site was carried out in 1908. At that time the habitat was beginning to change as a result of the cessation of many forms of 'traditional' management, but still retained many elements that characterised its past management and status.

The common has remained essentially unmanaged since the beginning of the twentieth century and as a result of this has been invaded by scrub and has developed into woodland. Surveys carried out in 1980 and 1993/1995 recorded mature woodland on the site and a comparison with the predominantly open habitats of 1908 showed the type and extent of the changes that had taken place. Aerial photographs taken in 1946, 1972, 1980 and 1988 gave an indication of the rate of change.

**Honing Common**

Honing parish has a large area of common land: Hind Holmes Common, Old Corner Common, St. Villiers Fen and Honing Town Land. Much of this land is wooded, although there are some areas of pasture close to the North Walsham and Dilham Canal.

Unusually, in an area of productive farmland, Honing appears to have lost very little of its common through enclosure. A few parcels close to the canal (Honing Severals) were enclosed to private ownership. In contrast, over a third of the common land in the adjacent parish of East Ruston was enclosed and allotted to private ownership, while the remainder was enclosed as poors land.

Bird (1909) noted that the enclosure of common grazing land at East Ruston "...left the peasant with a well drained and well fenced common in perpetuity, an inclosure which is...the envy of all neighbouring parishes whose commons are not thus protected...". Despite the fact that the poors land was well-drained and fenced, the loss of a third of the common land to private ownership must have had a significant

impact upon the local population and enclosure could be regarded as a process by which the poor of the district were deprived of their rights and impoverished.

**Past Management of Honing Common**

There is little information regarding the management of the common land at Honing at the beginning of the 20th century. However, a contemporary study of the management of the neighbouring East Ruston Common provides information relevant to Honing (Bird 1909). The land at East Ruston and Honing would have been quite similar and it is likely that the natural resources of wet fen, pasture, dry grassland and heathland would have been exploited in similar ways.

The inhabitants of East Ruston made considerable use of their natural resources. Peat was cut for fuel, turves for roofing, gorse for kindling and soft rush was gathered and peeled to make candle wicks. Each parishioner had the right to graze a limited number of animals on the site. All of these rights were closely governed by complex regulations (Bird 1909).

The management activities described above, by interrupting the natural succession, would have maintained open, unwooded vegetation with a variety of semi-natural habitats. Common rights appear to have been of great economic importance in this area until the late 19th century. However, by the early twentieth century there were no longer any restrictions on the quantities of hovers, turf or gorse allowed to each parishioner, or on the numbers of grazing animals (Bird 1909). Peat had been largely replaced by coal as a domestic fuel and peat cutting was practically obsolete. Bird observed that several areas of East Ruston Common were being invaded by scrub as a result of the low grazing intensity.

Gurney noted grazing at Honing Town Land in 1908 and there is also evidence for alder coppicing and peat digging. There is no indication that reed or sedge were cut in this area.

**Sources of Information**

Robert Gurney surveyed the Town Land section of Honing Common in 1908 as part of an ill fated attempt to survey the vegetation of Broadland (Driscoll & Parmenter 1994). He marked 11 compartments of land that he intended to survey on a copy of the relevant 1907 Ordnance Survey 6 inches to 1 mile map and made brief notes about the vegetation he found in 10 of these compartments. Gurney's annotated map and notes are held by the Natural History Department, Castle Museum, Norwich (Accession nos NWHCM: 1994.2 and NWHCM: 1994.3). The compartment numbers used below (see Figure 1) are taken from Gurney's map and notes and should not be confused with Ordnance Survey parcel numbers.

Clarke (1910) described the Town Land as "Heather, furze, alders, pasture." In a second paper on Norfolk Commons, he noted the existence of open mire habitats as well as alder swamp vegetation. He observed that the vegetation included stands of acidophilous plant assemblages: "Bordering many of the fen areas there is a

estricted wet heath association which...has arisen through the growing up of the en...bordering patches of gravel where the ground water is acid in reaction." (Clarke 1919).

Vertical aerial photographs of the Town Land were taken in 1946, 1972, 1980 and 1988.

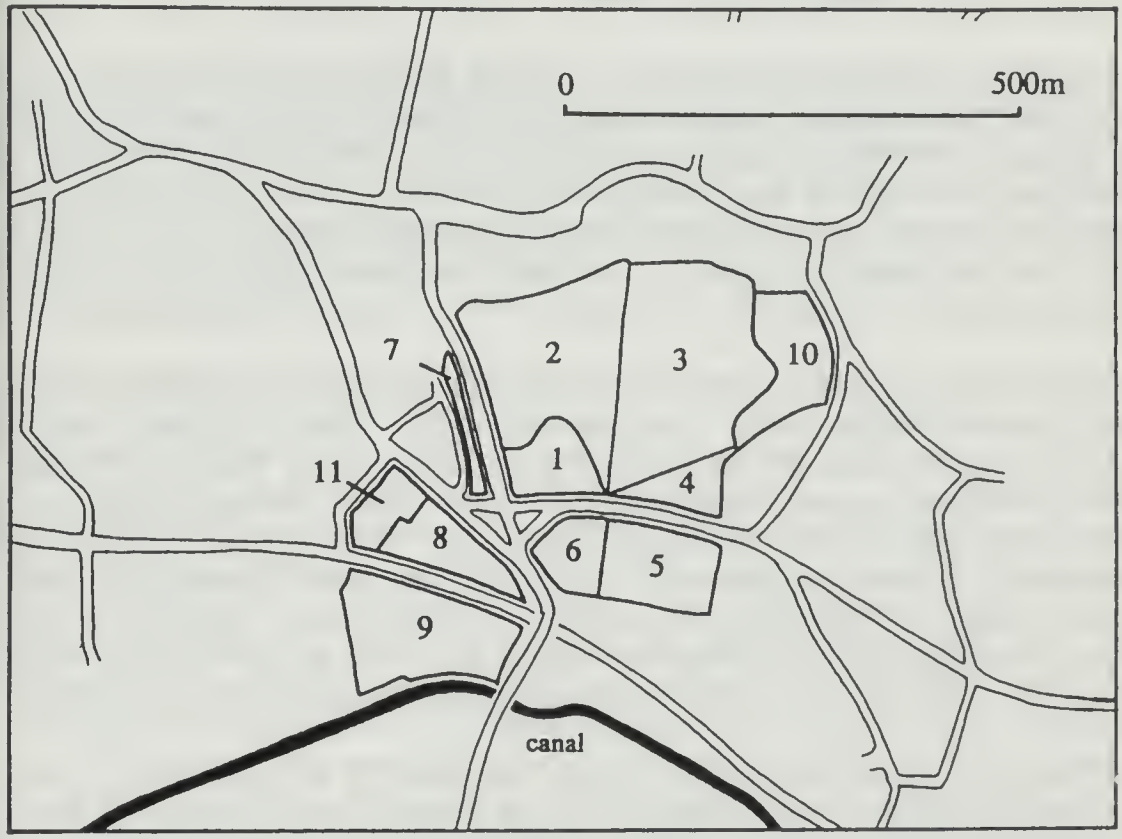


**Figure 1.** Map of part of Honing Common showing the compartments that were surveyed in 1908 and 1993/1995.

In 1980, the Nature Conservancy Council England Field Unit included Honing Common in a survey of 41 commons in Norfolk and Suffolk (Charman 1982). The ground flora of the Town Land was recorded in 4x4m quadrats in Compartments 2, 5 and 9 (1 quadrat in each compartment). The canopy was recorded in a 30x30m quadrat in Compartment 2. Brief notes were made about the vegetation throughout the rest of the site. Compartments 3, 5, 6 and 10 of Honing Town Land were surveyed in August 1993 and all 11 compartments were surveyed in September 1995. The vegetation in each compartment was briefly described and notes made of any indications of present or past land use (Parmenter & Driscoll 1995).

## Topography and Water Regime

The highest and driest parts of the site are the northern parts of Compartments 2 and 3 and the whole of Compartment 1. Compartments 4 and 10 and a narrow strip of land that follows the course of the road that runs between Compartments 1 and 4 and Compartments 5 and 6 are also higher and drier. Compartments 5, 6 and 8 are low lying and damp and Compartment 9 is very wet. A ditch drains in a southerly direction between Compartments 2 and 3, under the road and between Compartments 5 and 6 towards the canal.

The main source of water to the site, other than precipitation, is seepage from the underlying Norwich Crag. This water is predominantly acidic in reaction, although the presence in 1908 of *Schoenus nigricans* L. in Compartment 3 indicates that some parts of the site at least were influenced by water that was more base rich. The pH of the peat was measured when the ground flora quadrats were recorded in 1980. The pH values (at depths of 0.1m and 0.2m respectively) were: 6.5 and 6.6 in Compartment 2, 6.8 and 6.8 in Compartment 5, 6.8 and 6.6 in Compartment 9.

Despite the presence of the central drainage ditch, the site was evidently extremely poorly drained when it was surveyed by Gurney. This is apparent from the vegetation, which included *Drosera* spp. and *Calliergon* sp. Further evidence is that the low lying parts of Compartments 5, 6 and 9 were almost certainly cut for peat, presumably at some time in the 19th century. Peat accumulates only under permanently or semi-permanently waterlogged conditions. Honing Common is obviously drier now than at the beginning of the 20th century. This may in part be due to transpiration loss from the woodland, but could be the result of reduced spring flow. This in turn could be the result of water abstraction in the vicinity.

The land surface in this part of Norfolk undulates as a result of the uneven distribution of glacial and periglacial material. Gurney noted a number of pits and hollows in Compartment 10, which could have been the result of uneven glacial deposition, but were more likely to have been the result of sand and gravel excavation on the margin of the common. It is possible that some of the pools were dug to provide a water supply for domestic animals. Hollows were evident in Compartment 10 in 1993 when, after heavy rain, they rapidly became filled with water.

## Changes in the Vegetation

In 1908, much of the Town Land was open, with scattered alder thickets in Compartments 2, 5 and 6. Compartments 1 and 2 contained areas of acid mire vegetation in addition to grass heathand acid grassland. Compartment 3 was described as similar to Compartments 1 and 2 and appears to have supported an area of *Schoenus nigricans* mire. Compartments 5 and 6 contained small areas of alder woodland, with mire vegetation in the wettest places and drier heath vegetation closer to the road. Compartments 1 and 10 were described as unimproved pasture, with boggy patches and areas of heath. Compartments 4 and 10 were similar. Part of Compartment 7 was grass dominated. Several wet meadow and emergent aquatic

species were recorded in Compartment 9. Compartment 11 was damp pasture, grazed by ducks. Compartment 8 was not surveyed.

By 1946, the lower lying parts of the common, including almost the whole of Compartments 8 and 9 were wooded. Scrub appears to have been rapidly invading the damper, southern parts of Compartments 5 and 6, and the drier northern sections of Compartments 2 and 3. Compartment 10 was essentially open, as were Compartments 1 and 4 and the northern margins of Compartments 5 and 6.

In 1972, only a few fragments of the Town Land remained unwooded. The open areas included Compartment 1, much of Compartments 4 and 10, the north-eastern corner of Compartment 5 and the north-western margin of Compartment 6. There was evidence for recent management in the form of a large fenced area in Compartment 10. This may have formerly enclosed grazing animals, or could have been the remains of an allotment. A pond was visible in Compartment 10 on the 1972 aerial photograph.

By 1980, most of the site was wooded, predominantly by *Alnus glutinosa* (L.) Gaertner, but with abundant *Fraxinus excelsior* L. The northernmost parts of Compartments 2 and 3 were slightly drier than the rest of the woodland, with *Quercus robur* L., *Hedera helix* L. and *Rubus fruticosus* agg. growing with *Alnus glutinosa* and *Fraxinus excelsior*. The remainder of the woodland was quite damp, with species such as *Lonicera periclymenum* L.,*Carex remota* L. and *Valeriana dioica* L. commonly occurring. In the wettest areas, Compartments 5, 6, 8 and 9, the understorey included *Carex acutiformis* Ehrh.,*Berula erecta* (Hudson) Cov. and *Solanum dulcamara* L. The easternmost parts of the site were relatively open. Compartment 10 consisted of wet *Arrhenatherum elatius* (L.) P.Beauv. ex J.S.Presl & C. Presl dominated grassland, with associated fen species, growing amongst dense young *Salix*, *Alnus* and *Prunus* scrub. The eastern part of Compartment 4 was described as rough grassland with scrub. Compartment 11, a playing field, had been re-seeded with *Lolium perenne* L.

The 1980 aerial photograph showed the fenced area in Compartment 10, which was evidently no longer managed in any way as there was some considerable scrub growth visible. The pond was still visible, and several pools could be seen close to the road.

When the Town Land was surveyed in 1993/5, virtually the entire site was wooded, with open areas only in Compartments 4, 10 and 11. Compartment 11 was a *Lolium perenne* dominated playing field. The open areas in Compartments 4 and 10 were restricted to the eastern margins of the compartments. Compartment 10 contained areas of open marshy grassland supporting a few fen species and surrounded by rapidly encroaching alder scrub. Compartment 4 was much drier, with a few areas of open grassland surrounded by young *Prunus* and *Salix* scrub close to the road. Compartments 1 and 7 and the northern parts of Compartments 2 and 3 were relatively dry woodland, with mature *Quercus robur*, some *Alnus*

*glutinosa* and *Fraxinus excelsior*. The ground flora included *Carex remota*, *Lonicera periclymenum* and *Rubus fruticosus* agg. The wetter areas of woodland included the southern parts of Compartments 2 and 3, the northwestern part of Compartment 4, and Compartments 5, 6 and 8. *Alnus glutinosa* was the most common tree species in these areas, although *Quercus robur* and *Fraxinus excelsior* were not infrequent. The ground flora included *Calystegia sepium* (L.) R.Br., *Carex remota*, *Dryopteris dilata* (Hoffm.) A.Gray, *Solanum dulcamara* and *Berula erecta*. Compartment 9 was extremely wet, with *Alnus glutinosa* carr growing over *Carex remota* and *Berula erecta*. A number of massive coppice stools of *Alnus glutinosa* was noted in the woodland throughout the site.

The three sets of survey data from Honing Town Land and the aerial photographs record the progressive development of woodland over the course of the 20th century. From a predominantly open site in 1908, with areas of acid grassland, rough pasture and mire vegetation, with occasional thickets and mature trees, there has been an almost complete change to a predominantly wooded site, with a few small areas of open acid grassland and former pasture, now unmanaged.

**Botanical Significance of Honing Common**

Honing Common first appears to have been recognised as an interesting botanical site in 1894, when it was visited by a party from the Norfolk and Norwich Naturalists' Society (Southwell 1894). *Epipactis palustris* (L.) Crantz, *Parnassia palustris* L. and all three *Drosera* species were found, although the precise localities were not recorded.

Honing Common was subsequently noted as a station for the rare fen orchid, Liparis loeselii (L.) Rich. Bennett (1904) reported that this species had been found "on a very boggy part of Honing Common, near the railway".

Although Gurney noted *Drosera* spp., *Epipactis palustris* and *Parnassia palustris* in 1908, there is no indication that he regarded these species as being of particular interest. It must be assumed that their occurrence was then not thought of as being unusual, whereas today they would be considered to be of very great local importance.

None of the above species are present on the common today and there appear to be no habitats suitable for them. Other interesting species have been noted however, for example, the moss *Hookeria lucens* (Hedw.) Sm. was recorded from a bank running between Compartments 2 and 3 in 1995 (A.L.Bull, pers.comm.). This species is not uncommon nationally, but is extremely rare in eastern England; an indication that the woodland on this site may be of some ecological interest.

**Discussion**

Without some form of management intervention, much of lowland Britain would develop into woodland within the space of a few hundred years. Many of the 'natural' open habitats which are valued highly by ecologists and the general public

alike are wholly or partly dependant upon some form of management or other human influence in order that they retain their open state. This influence could be quite intentional, for example, management by mowing or grazing livestock on grassland, or entirely accidental, for example, grazing by rabbits, a species introduced to Britain by man. In the absence of mowing or grazing grassland and other types of herbaceous vegetation are rapidly invaded by woody species and eventually become woodland.

The Town Land at Honing, when it was under active management, supported a mosaic of habitats including acid mire, wet heath, dry and damp grassland, and coppice woodland. As a result of a decline in management, probably in the late 19th or early 20th century, the process of scrub invasion and woodland development began at Honing Common. Woodland and scrub were well established in 1946 and by 1980 much of the site was dominated by alder woodland.

The vegetation recorded in 1993/1995, despite being mostly woodland, was not homogeneous. Some of the variation in the vegetation was the result of different types of past management, for example, the damper areas in Compartments 5 and 6 were probably associated with former turf cuttings, while the site of a pond which was recorded by Gurney in 1908 was occupied by a wet area that supported damp loving species. Some of the variation was due simply to the variety of environmental conditions throughout the site. The ground rises to the north and alongside the road. These areas supported dry grassland and heath in 1908 and dry woodland in 1995.

In the absence of management, dry ground is usually colonised by woodland more rapidly than wet ground. With a few exceptions scrub invaded the damper regions of Honing Town Land before it began to encroach on the drier ground. This suggests that traditional management of the wetter parts of the site ceased before that of the drier areas, which may have still been sporadically grazed when the 1946 aerial photograph was taken.

The vegetation at Honing Town Land has reached a more or less stable state. Although the woodland will continue to develop and become more species rich, the changes that will take place in the foreseeable future will be much less obvious than those that have happened in the past.

**Acknowledgements**

We would like to thank the following: Scott Coe, Department of Planning and Transportation, Norfolk County Council for the use of the 1988 aerial photographs and Derek Edwards, Norfolk Landscape Archaeology Section, Gressenhall for the use of the 1946 and 1972 aerial photographs. Tom Williamson of the Centre of East Anglian Studies, University of East Anglia commented on the text and Tony Irwin, Natural History Department, Castle Museum converted the original LocoScript file into a more accessible form.

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ISSN 0375 7226 Printed by Colorprint, Fakenham £4. 50